ARCHIVES of OPHTHALMOLOGY

VOLUME 12 (old series Volume 69) NOVEMBER 1934 NUMBER 5

USE OF THYROXIN IN OPHTHALMOLOGY

ITS APPLICATION AS A LOCAL AGENT AND ITS ACTION AS A METABOLIC ALTERATIVE

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Dr. William Browning, the neurologist in Brooklyn, who thirty-five years ago was among the first in this country to recognize the value of glandular therapy, recently asked me if the use of thyroxin in ocular conditions had ever been considered. On his own initiative, about a year ago, he instilled a solution of natural crystalline thyroxin (1 mg. to 1 cc.) in his eye, first once a week and later more frequently. The interesting results he experienced (related under "clinical notes") inspired me to make further investigation at his suggestion.

Before giving the dosage and reporting the cases in which I used thyroxin in the eye, I wish to touch on the recorded general biologic history and attributes of this subtle and potent drug.

BIOLOGIC AND CHEMICAL EXPERIMENTATION

In 1913 and 1914 Gudernatsch made the discovery that tadpoles fed on meat usually showed distinct hindlegs in fifty-three, forelegs in seventy-three and complete metamorphosis in one hundred and four days, while tadpoles fed on thyroid showed hindlegs in nine, forelegs in eleven and complete metamorphosis in from eighteen to twenty days. No such effect could be produced by feeding them any organ other than thyroid.[1]

It was not even necessary for the tadpoles to be actually fed thyroid. When pieces of thyroid were suspended in tanks the effect was equally shown by their absorbing the emanations of the thyroid. Later experiments showed the same acceleration of metamorphosis following administration of natural and synthetic thyroxin.[2]

The frogs produced by the rapid metamorphosis of thyroid-fed tadpoles are, however, pigmies and do not survive more than a few days. Harington stated therefore that thyroid has a remarkable power of "stimulating differentiation of form not growth." [2]

If this is always true, the fact of growth and weight being decreased while form is greatly accelerated provides, of course, theoretically an intriguing medium for ocular work.

1. Harington, C. R.: The Thyroid Gland: Its Chemistry and Physiology, New York, Oxford University Press, 1933, p. 118.
2. Harington,[1] p. 119.

The rather general conclusion from biologic experimentation has been that thyroxin has a peripheral action on tissues. Opinion is, however, divided. Myhrman first stated that "the increase in the organisms' consumption of oxygen occurring sometimes after the addition of thyroxin has been a well known fact. As to the manner in which thyroxin exerts the action, the general opinion appears to be that after the resorption, the thyroxin is transferred to the cells and influences their metabolism directly as a catalyzer. This opinion also seems to have been the earliest from the historical point of view." [3]

Myhrman then demurred to his former opinion and stated that in spite of the chemical experiments of Eppinger and Hofer who believed that the healing of wounds was accelerated by local treatments with thyroid glandular extracts [3] and in spite of the experiments in which Gunnar Algren [4] "constantly found an accelerating action of the thyroxin on the oxidation processes of surviving tissues" he believes that "the support to be derived from the former [Algren's experiments] in favor of the presumption of peripheral thyroxin action is rather frail" [5] and that in his own experiments he was not able to observe any such accelerating action. Myhrman now presumably believes that thyroxin acts solely through the nervous system.

I am in no position to enter this biochemical controversy but I wish to direct attention to evidence gathered in my clinical experience pointing to the fact that, whatever the action may be, through the nervous system, the circulation or the lymphatic system, a definite alterative and stimulative action is produced by the topical action of thyroxin in the eye.

STANDARDIZATION OF DOSAGE AND ADMINISTRATION OF THYROXIN FOR THE EYE

Thyroxin, the active principle of thyroid, was isolated by E. C. Kendall and his assistants in the section of Biochemistry of the Mayo Foundation in 1919.

The general action of the crystalline product is subtle. No therapeutic action is noticeable for three or four days. Toxic symptoms or the maximum effect does not occur before eight or ten days, and the effect of a single dose continues for three or four weeks. The first physical toxic symptom is rapidity of the pulse rate.[6]

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3. Myhrman, G.: Some Investigations into the Influence of Thyroxin of Tissue Oxidation, Acta med. Scandinav. **79**:323, 1932.

4. Algren, G., quoted by Myhrman,[3] p. 324.

5. Myhrman,[3] p. 326.

6. Squibb, E. R., and Sons: Brochure issued on thyroxin under license from the University of Minnesota Biological Laboratory (U. S. Government License no. 52), p. 5.

As there is no successful substantiated record of the topical and local use of thyroxin in the literature, I attempted to standardize the solutions for the eye so that they could be used intelligently.

The dosage and administration presented considerable difficulty: 1. The natural crystal as isolated by Dr. Kendall, while efficacious, is unstable and, unless kept at a low temperature and in the shade, quickly deteriorates. It keeps well in the icebox.

2. Thyroxin is soluble only in sodium hydroxide, and the hydroxide, if used in improper solution, is irritating to the eye, and if used in excess may be escharotic.

3. In the nonirritant solution the amount of thyroxin is of necessity limited.

It is stated by Squibb that 10 mg. of thyroxin can be dissolved in 1 cc. of water, but in order to obtain that solution 1 drop of a normal 4 per cent solution of sodium hydroxide per cubic centimeter is necessary.

The directions[7] for making up the crystals for intravenous use are as follows: Place the required amount (from 1 to 10 mg.) of pure crystalline thyroxin in a small sterile tube, such as is used for Wassermann tests. Add 1 drop of a 4 per cent solution of sodium hydroxide and about 1 cc. of water; heat and agitate the solution until the crystals are dissolved.

The manufacturer states that at the present writing this is the only method by which the pharmacist dissolves thyroxin for use in fresh solutions.

A change in the prescription to one half the strength of hydroxide should, however, be made for the eye, as I have found that the instillation of a solution of 1 drop of a 4 per cent solution of sodium hydroxide to the cubic centimeter is too severe for the conjunctiva and is followed by too much smarting and pain.

The strength of the sodium hydroxide solution therefore has to be reduced to ½ minim (0.03 cc.) to the cubic centimeter, and in this solution, according to Squibb, only 5 mg. can be dissolved. Therefore when thyroxin is used, the present knowledge of natural crystalline thyroxin allows a range of strength from 1 to 5 mg. per cubic centimeter; this can be used without producing irritation of the conjunctiva.

I soon found definite proof of the fact that, at least in solutions up to 10 mg. in 2 cc., thyroxin does not irritate the conjunctiva. It is only when the sodium hydroxide, its solvent, is used in quantities of more than one-half minim to the cubic centimeter that marked irritation of the conjunctiva is noted. These results have been obtained by definite instillations of the weaker and stronger solutions in the human eye.

7. Squibb and Sons,[8] p. 14.

The second instillation is followed by less pain and smarting than the first. I attribute this not to any anesthetic quality, but to the slightly escharotic quality of the sodium hydroxide solution. The solution of 1 mg. to 1 cc., advocated for intravenous use, is too strong to be comfortably tolerated by the conjunctiva in the first instillations.

Another obstacle to the use of the natural crystal is its high cost (2.40 for 10 mg. wholesale).

Beside the natural crystalline solution a synthetic product may be used. This was discovered by Harrison and Barger in 1926 and turned over to the Hoffmann-La Roche chemical works. Of this product Grafe [8] said: "The effect is not immediate any more than it is with the older preparations but may be expected to act in a few days," and Harington [2] added that all that has been accomplished with the natural crystalline product, even in the experiment with tadpoles, has also been accomplished with the synthetic product.

If such identity with the natural product continues to be substantiated, this synthetic product will prove valuable because of its stability in keeping indefinitely and because of its lower cost.

For ophthalmic administration of the synthetic product, a solution containing 2 mg. per cubic centimeter, now on the market, can be instilled two or three times a day undiluted. This is inexpensive, does not deteriorate in ordinary temperature and can be sterilized. If a weaker solution is desired, it can be diluted with sterilized water.

To date my clinical experiments have been performed with the natural product and in using that I wish to caution against the use of the promiscuous prescription prepared by druggists not very definitely instructed about the sodium hydroxide content.

The maximum strength of thyroxin must be only 5 mg. to 1 cc. Dr. Browning himself used the solution of 1 mg. to 1 cc. once a week; later he used the same solution more frequently. I have since used it in increasing doses up to 5 mg. to 1 cc. once a day without producing toxic symptoms or marked disturbance in the normal eye.

Knowing this, from the standpoint of the irritation of the sac alone, one need not be afraid of introducing into the conjunctival sac amounts up to 10 mg. to 2 cc. of water.

The question arises, however, as to the possible overstimulation of hypermetabolic activity and overcumulative effect on the ocular lesion. Experience will solve the problem of how far this agent may be pushed. But the subtle quality of the drug is such that I believe that this solution should be used cautiously until the question of cumulative effect is determined.

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8. Grafe, E.: Metabolic Diseases and Their Treatment, translated by M. G. Boise, Philadelphia, Lea & Febiger, 1933, p. 185.

That there is likely to be no general toxic effect is evident from the fractional amount contained in 1 or 2 drops of the solution administered by instillation as compared with the minimum intravenous dose.

One can probably use thyroxin subconjunctivally without reaction if a higher dosage is required. But again, in dealing with such a subtle and potent drug one must use great caution until definite knowledge as to cumulative effect is established.

This investigation was begun in the hope of ascertaining whether thyroxin is a local metabolic stimulator of cell activation—in which expectation Dr. Browning used it in his own eye—and whether it has active alterative qualities when applied locally.

Thyroxin has been administered to about seventy-five patients. The effect of thyroxin in many of the acute cases has been so unusual as to be strikingly impressive.

Some of the changes in the lens have remained in status quo and some have materially improved, but in the short period of four months it is hard to come to a definite decision as to how far lenticular opacities can be eliminated or influenced.

It is doubtful whether well developed nuclear changes can be influenced, but thyroxin may prove valuable in retarding incipient opacifications.

Tension, undoubtedly, is moderately reduced, and thyroxin may prove valuable in assuaging tension incident to tumefaction of the lens and has the advantage of not contracting the pupil.

Cases of floating vitreous opacities have been noticeably helped, and in a large proportion of keratitic conditions the improvement has been striking.

REPORT OF CASES

CASE 1.—For a year Dr. Browning had suffered from changes in the lens which gradually increased. In addition he had slight exacerbations of tension for which he had been using physostigmine, which he continued to use during the early period of administration of thyroxin.

As Dr. Browning has only one eye and knew the subtlety of the latter drug, courage was required to use it. Within a short period after the first instillation of the thyroxin, while he noticed only a small amount of increased clarity for distance, his vision for near work increased markedly. He stated, and I observed, that while he previously read only with the aid of a 4 inch (10.16 cm.) lens, he now read Jaeger test type no. 4 quite easily and fluently without artificial help and that for the period of an evening, whereas previously he could maintain the effort only for short intervals. In addition to this he noted (having become quite astute at taking his own tension) that it no longer was subject to exacerbations. He therefore discontinued the use of physostigmine, but the eye maintained a slight subnormal tension.

My first feeling would have been that these changes were due to the coincidences of varying vision not infrequently noted with progressive changes in the

lens, but as I had had his eye under observation for several years and had never noted any changes beside steady progression, and as I knew well his balanced judgment and integrity, the incident provided material for thought.

Case 2.—A rapid and marked improvement was recorded in the case of Mr. A. B. whom I had previously treated for recurrent kerato-iritis. This had been eliminated only after long periods of inflammation. The patient had first endeavored to treat the present attack himself by the instillation of atropine and by hot fomentations.

When he came into the office his vision was 20/200; the pupil was immobile, contracted and slightly occluded with a thin membrane; there were small petechial hemorrhages on the surface of the iris; the crypts were blocked; various tests gave negative results, and the tension was slightly increased. Twelve days after the patient had used a solution of natural thyroxin in the strength of 1 mg. to 1 cc., at first on alternate days and later daily night and morning, the eye appeared normal.

The pupil was well dilated; the iris had largely resumed its normal markings; hemorrhages had disappeared, and vision had improved from 20/200 to 20/40. This may quite reasonably be interpreted as a coincidence, but I have never seen as spectacular a parallel in an identical case.

Case 3.—Mrs. C. D. had had an attack of keratitis which lasted six months about six years previous to the present attack. The latter attack had progressed for two months before I saw her.

The teeth had been extracted. The Wassermann test gave negative results, and a faint subcutaneous reaction to the tuberculin test was observed. She was not tuberculinized. Two areas of deep infiltrating keratitis, one extending from the nasal limbus and another from the upper and outer quadrant of the cornea almost to the pupillary margin, were present. The iris could not be seen through these areas.

There was a slight thickening of the limbus, intense photophobia, and a marked acute reaction, more than would be noted in a tuberculous lesion. Twelve days after the use of thyroxin, 1 mg. to 2 cc., the condition presented rapid and marked improvement.

The infiltrated nasal area had nearly disappeared. The markings of the iris could be observed distinctly through the cornea. The superior area had likewise melted away, leaving only a slight line of gray infiltration approximating the pupillary margin. Between this and the limbus, the infiltration of the cornea which previously entirely obscured the markings of the iris had cleared, and the markings were easily perceptible. The eye had quieted down and had made a good recovery.

Case 4.—Miss E. F. had a slight corneal opacity of long standing. She volunteered to have tension measured before and after using thyroxin (see under tension). She was a hypermetrope with 20/200 vision without glasses and 20/30 with a correction of +2.00 sph.

After using a solution of thyroxin, 1.5 mg to 1 cc., for four days, she had vision of 20/70 without and of 20/20 with glasses. Previously she had not been able to read Jaeger test type no. 4 without correction, but after using thyroxin she could do so without glasses at 14 inches (35.56 cm.).

This improvement could not have been due to direct action on the cornea. It has, however, been maintained to date, although the thyroxin was stopped.

The eye which for many years had been hypersensitive to light lost this sensitivity, and perceptible widening of the palpebral fissure became noticeable. In

this case one of the highest dosages administered was given and there was slight temporary inhibition of the orbicularis.

There is a possibility in this instance that the change in refraction was due to the dissipation of the hypersensitivity which relaxed the pressure of the lid and that this in turn altered the corneal curvature.

CASE 5.—Mrs. G. H. had recurrent attacks of iritis following an operation for the removal of a cataract; one of these attacks completely occluded her pupil, necessitating iridotomy. Prior to the iridotomy, vision was restricted to perception of shadows; after the operation 20/70 vision was obtained. Shortly after the iridotomy the new pupil was hazed with another exudate. The patient was given thyroxin, 1 mg. to 2 cc., night and morning. After twelve days the pupil cleared; the reaction subsided; vision increased 50 per cent, and the patient stated that "the bunch of weeds" which had been very marked had disappeared.

CASE 6.—Mr. I. J. had a postoperative injury with considerable reaction and much vitreous débris. A protruding iris had been iridectomized, and a slight extension of the ciliary wound into the sclera had been covered with a triangular subconjunctival flap. For five weeks up to the time of the administration of thyroxin vision had constantly remained restricted to shadows at 2 feet (60.96 cm.). Sixteen days after the use of a 1 mg. to 2 cc. solution of thyroxin night and morning the vitreous opacities had thinned and the patient distinguished fingers at 4 feet (1.21 meters). Two weeks later 15/200 was obtained.

ADDITIONAL USES OF THYROXIN

Incipient Cataracts.—These have constituted the largest number of cases (twenty-five) in which thyroxin was used. None has shown retrogression to date; in the majority slight improvement has been noted. In a well developed case the vision improved from 7/200 to 20/200 in a month. I believe, however, that with the well known erratic improvement of incipient cataracts it is too soon to pass judgment on the amelioration of the changes in the lens.

Tension.—I believe that there is no question but that tension is moderately reduced although there is no contraction of the pupil. This is also Dr. Browning's opinion in his own case. In the instance of the volunteer with normal tension, using Schiötz tonometer (5.5 Gm. weight), the tension was reduced from 18 to 12 mm. of mercury after the use of a 1.5 mg. to 1 cc. solution of thyroxin night and morning. Patients have stated that some hours after the introduction of thyroxin they noted slight improvement of vision. The question of reduction of tension, though already substantiated in a number of cases, must be further pursued.

Tenderness.—The tenderness without inflammatory reaction sometimes revealed by pressure over the ciliary body and muscles and probably of rheumatic origin is relieved by thyroxin.

Vitreous Opacities.—Obvious improvement occurring after the use of thyroxin has been noted in vitreous opacities. In three of six cases marked improvement was observed following the use of thyroxin; in

the fourth the small opacities greatly diminished and the larger ones dissipated considerably in density; in the fifth the opacities dissipated so as to be unnoticeable, and in the sixth, an old case of chronic flocculent branchlike opacities, complete recovery was reported.

GENERAL COMMENT

There are many questions to be decided. Basal metabolism may throw light not only on dosage but also on the effect of thyroxin, and experience will show whether it is necessary to determine the basal metabolism or not. However, the fractional dose achieved by the instillation of even 5 mg. to 1 cc. is so small that a toxic effect is not likely to occur.

Another of the questions which must be answered is whether the alterative stimulation excited by thyroxin will be permanent and sufficient to eliminate acute conditions having a definite constitutional etiology. This could hardly be expected. It appears, however, if my observations are substantiated, that the subtle prolonged quality of its action is such that it may prove a powerful and virile agent to use coincidentally with the systemic treatment necessary.

I believe that the penetrative property of thyroxin is due to the fact that it contains "65 per cent iodine organically combined as an integral part of the molecule."[9] According to Parsons,[10] who cited Gosselius as an authority, iodine penetrates the cornea of a rabbit in one and one-half minutes and is found in the anterior chamber in two minutes. One may at least presume that thyroxin permeates the human cornea and enters the anterior chamber, and also permeates the lens by osmosis.

I believe that it is not the quantity of iodine alone that produces the alteration because I have not been able to obtain the same clinical success with it as with thyroxin, although I have used potassium iodide and glycerin for many years in ocular work.

I have been asked whether the alkaline hydroxide plays any part in the improvement in the cases reported. Certainly other alkaline preparations that I have used in the past have not produced such clinical results in the eye. But it is probable that both the alkaline hydroxide and the iodine in combination with the thyroxin are of contributive value. This, however, has probably been true also to a certain extent in the general use of thyroxin. It is significant that in the normal eye the same solution of sodium hydroxide without the thyroxin content does not reduce tension in a material degree.

The symptoms of overstimulation or cumulation thus far recorded in the larger and longer continued dosages are a feeling of suffusion or

9. Squibb,[6] p. 40.

10. Parsons, J. Herbert: The Pathology of the Eye, London, Hodder & Stoughton, Ltd., 1906, vol. 3, p. 1001.

pull in the eye, slight inhibition of the orbicularis, widening of the palpebral fissure and what Dr. Browning has described as a group of mild and not persistent paresthesias. These are not produced by hydroxide, iodine and glycerin alone.

I have not found a theory so far advanced to support the belief that any topical alterative in its action on the eye is as effective from a biologic and therapeutic standpoint as is thyroxin.

I realize, however, the possibility of attributing spontaneous natural improvement to the agent promoted, as is often the case in advocating a new therapeutic remedy. But clinical evidence has appeared more striking to me than natural improvement could account for, and I believe that it substantiates Dr. Browning's first conception and my later hope of the establishment of thyroxin as a local metabolic stimulant and alterative.

MENINGIOMAS ATTACHED TO THE MESIAL PART OF THE SPHENOID RIDGE

WITH SYNDROME OF UNILATERAL OPTIC ATROPHY, DEFECT IN VISUAL FIELD OF SAME EYE AND CHANGES IN SELLA TURCICA AND IN SHAPE OF INTERPEDUNCULAR CISTERN AFTER ENCEPHALOGRAPHY

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Our object in this paper is to call attention to a characteristic symptom complex of small meningeal growths which arise from the most mesial part of the sphenoid ridge. These growths lie in close proximity to one optic nerve, and for a considerable period they produce disturbances due solely to pressure on the nerve near the optic foramen.

The syndrome of primary atrophy of the optic nerve with bitemporal defects of the visual fields and progressive diminution of vision is characteristic of tumors which compress the optic chiasm and nerves and is often the first and, for a long time, the only clinical evidence of a midline growth underneath the frontal lobes of the brain. The combination of primary atrophy of the optic nerve, bitemporal defects of the visual fields and changes in the sella turcica was formerly believed to be characteristic solely of tumors of the hypophysis. We now know that the chiasmal syndrome may be produced by cysts or solid growths derived from the bucconeural pouch or infundibular stalk, by primary gliomas of the optic chiasm, by localized inflammatory processes in the leptomeninges and frequently by midline meningiomas attached to the basilar dura of the anterior or middle cranial fossa.

During the past decade particular attention has been directed to the meningiomas which have increasingly often been found and removed by the neurosurgeon. In the beginning of that period, isolated reports of cases of suprasellar and parasellar meningiomas appeared in the literature; in 1927 a paper on a series of suprasellar meningiomas was published by Holmes and Sargent.[1] In most of the cases the tumor was recognized and operation performed when the growth was large.

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Read in part by one of the authors before the Section of Ophthalmology, New York Academy of Medicine, May 21, 1934, and read at the Sixtieth Annual Meeting of the American Neurological Association, Atlantic City, N. J., June 6, 1934.

1. Holmes, G., and Sargent, P.: Suprasellar Endotheliomata, Brain **50**: 518 (Oct.) 1927.

The early recognition of the suprasellar meningiomas at a stage when, by pressure on the chiasm and optic nerves, they produce disturbances of vision alone was due to Cushing; and in 1929, in a paper entitled, "Meningiomas Arising from the Tuberculum Sellae, with the Syndrome of Primary Optic Atrophy and Bitemporal Field Defects Combined with a Normal Sella Turcica in a Middle-Aged Person," a clinical syndrome was described by Cushing and Eisenhardt.[2] The optic chiasm was found to be dislocated backward, and it and the optic nerves straddled the neoplasm. Both optic nerves were pressed on, although the growth often extended more to one side. There were bitemporal defects of the visual fields and, in more advanced stages, blindness of one eye and a temporal defect in the visual field of the other eye.

The title of the paper by Cushing and Eisenhardt contains the statement that the sella turcica was normal, but from the description of the roentgenograms by the authors it is evident that changes in the sellar floor or the clinoid processes were often observed. In the roentgen films made in our cases of meningiomas attached to the dura of the tuberculum sellae, atrophy of the floor of the sella turcica or of one or both anterior or posterior clinoid processes was usually found. It is therefore more correct to state that these growths often produce changes visible in the roentgen films, but that the widening and deepening of the sella turcica which is characteristic of primary intrasellar growths does not occur.

The publication of the article by Cushing and Eisenhardt inaugurated a new era: The combination of primary atrophy of the optic nerve and bitemporal defects of the visual fields with slight changes in the sella turcica but without any other symptoms of intracranial tumor was now recognized as a syndrome produced by slowly growing meningiomas in the neighborhood of the optic chiasm. Increasingly often the disease was recognized, and the patients were operated on at a time when the tumor was small and before irreparable damage to the optic nerves had occurred.

Cushing and Eisenhardt made the following statements:

> Certain other meningiomas, which ophthalmologists should be quick to recognize, take their origin from the basilar leptomeninges in the vicinity of the pituitary fossa. Many of them have a distinctive symptomatology . . . others with equally unmistakable manifestations arise from the sphenoidal ridge lateral to the sella turcica and implicate the adjacent optic and oculomotor nerves; still others may actually arise from the meningeal expansions constituting the sheath of the optic nerve within the cavity of the orbit.

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2. Cushing, Harvey, and Eisenhardt, Louise: Meningiomas Arising from the Tuberculum Sellae, with the Syndrome of Primary Optic Atrophy and Bitemporal Field Defects Combined with a Normal Sella Turcica in a Middle-Aged Person, Arch. Ophth. **1:1** (Jan.); 168 (Feb.) 1929.

The meningiomas which arise from the dura which covers the upper surface of the lesser wing of the sphenoid and those attached to the lateral part of the sphenoid ridge do not primarily make pressure on the chiasm. In the early stages of their growth and, in fact, not until they are large do they produce changes in the visual fields. When they have attained considerable size they may cause bilateral papilledema or primary atrophy of the nerve, or primary atrophy in one eye and papilledema in the opposite eye. There may be concentric contraction of the visual fields or homonymous hemianopia. In our experience the so-called Kennedy syndrome is infrequent and occurs only with large growths in or underneath one frontal lobe.

Recently, from the clinic of Dr. Charles H. Frazier, Alpers and Groff [3] described a series of four meningeal fibroblastomas attached to the dura of the lesser wing of the sphenoid bone and four attached to the greater wing. Most of the growths were of large size and produced symptoms by pressure on the chiasm and the optic and other cranial nerves. In only a few instances could the growths be completely removed. Alpers and Groff stated that the growths of the lesser wing are characterized by a definite syndrome, which they described as follows:

> The type of clinical syndrome to be expected, therefore, from tumors of the lesser sphenoid wing consists of a visual field cut, which is usually a complete homonymous hemianopia but which may be quadrantic, with localizing signs indicating involvement of the base of the brain, such as primary optic atrophy, a Kennedy syndrome, paralysis of the third nerve and unilateral impairment of the olfactory nerve. Other symptoms, such as motor paralysis of a central type (monoplegia), impairment of memory and pituitary disturbances may be present . . . the sella turcica may be normal or may show changes similar to those described in parasellar lesions . . . slight erosion of the dorsum and the anterior clinoid processes and unilateral deformation of the sella turcica in some instances . . . Usually the tumors of the lesser wing are small and are rather closely confined to the vicinity of this wing. . . . Usually the tumors compress one or both optic nerves and the optic tract on one side when they are in contact with the lesser wing; they may likewise compress the olfactory nerve of one side, the oculomotor nerve, the uncus and the internal carotid, the middle cerebral or the anterior cerebral vessels.

The combination of symptoms described by Alpers and Groff is characteristic of large growths derived from the dura of the lesser and greater wings of the sphenoid, and many of the subjective and objective disturbances were obviously due to the large size of the neoplasm and the involvement of many areas of the brain. A considerable number

3. Alpers, B. J., and Groff, R. A.: Parasellar Tumors: Meningeal Fibroblastomas Arising from the Sphenoid Ridge, Arch. Neurol. & Psychiat. **31:** 713 (April) 1934.

of patients with these symptoms have been operated on in the surgical service of the Neurological Institute and in practically all of them the neoplasm was large, often weighing from 50 Gm. to 200 Gm. or more. The patients were frequently seen at a time when the diminution of vision was far advanced: Sight in one eye had been lost and that of the other greatly reduced. Tragically, not a few patients were admitted to the hospital and subjected to operation when they had only perception of light or when all vision had been lost from a primary or secondary atrophy of the optic nerve. In other words, many persons who are suffering from a benign subfrontal growth are seen by the neurologist and referred to the neurosurgeon in an advanced stage of their disease. A better appreciation by the patient of the importance of slight visual disturbances and by the physician of the significance of slight symptoms is needed. This, together with the more frequent use of new diagnostic methods, will surely bring about improvement in the ability to recognize the growths when they are small.

An important advance in the knowledge of the life history of these growths was made by the demonstration of definite sites of predilection for their meningeal origin and attachment. Among the favorite sites of attachment may be mentioned: (1) the dura which covers the tuberculum sellae, (2) the dura of the olfactory groove and cribriform plate, (3) that of the roof of the orbit, (4) that on the superior surface of the lesser wing of the sphenoid, (5) that of the outer part of the sphenoid ridge and (6) that of the mesial part of the sphenoid ridge. When they are small, the meningiomas attached to the dura at the sites mentioned under 3, 4 and 5 do not come into contact with structures that have a specialized function; therefore, it is not surprising that for a long time many of the patients are free from disturbances which would lead them to consult a physician.

The meningiomas which are derived from the dura of the tuberculum sellae produce visual disturbances early and, as was demonstrated by Cushing and Eisenhardt, they can be recognized when they are small.

Small growths attached to the dura of the olfactory groove must cause unilateral disturbances of smell very early, and if and when better tests of the function of the olfactory nerve have been devised,[4] it will be possible to recognize meningiomas in this situation before they have grown to large proportions. The value of encephalography for patients with disturbances of smell not clearly due to intranasal disease is self-evident, and in the future this diagnostic method should be used more often than it has been in the past.

4. The tests of the sense of smell now used are very gross. It is to be hoped that the rhinologist will devise more delicate tests of the function of the olfactory nerve. Perhaps these tests will be electrical.

It was natural to predicate that growths derived from the dura of the mesial part of the sphenoid ridge would first produce symptoms by pressure on one optic nerve; i. e., they should at first cause disturbances of vision in one eye. The cases that form the basis for this paper demonstrate that by studies of the visual fields and by the recognition on roentgen films of changes in the basal cisterns after encephalography growths in this situation can be diagnosticated when they are small.

We became especially interested in this subject when, in close succession, three cases were observed with unilateral disturbances of vision and defects in the visual fields of one eye due to growths attached to the mesial part of one sphenoid ridge. The diminution of vision in one eye of which the patients complained was slowly progressive, but aside from the examination of the eyes the clinical studies failed to reveal anything characteristic of an intracranial neoplasm. There were no disturbances of any other cranial nerves, and particularly the functions of the olfactory and the motor oculi nerves were not interfered with. In each case encephalography was done, and the roentgen films showed characteristic changes in the shape of the interpeduncular cistern. This indicated that the patients were suffering from a small expanding lesion within the cranial cavity, which was so situated as to press on one optic nerve near the optic foramen and to produce a deformity or filling defect of the interpeduncular cistern.

Recently, we studied a fourth case in which operation was performed. The clinical picture and the roentgen findings were characteristic of a growth attached to the mesial part of the sphenoid ridge, but the patient had complete anosmia, which was due to long-standing disease of the sphenoid sinuses and maxillary antrums.

REPORT OF CASES

CASE 1.—*History.*—E. W., a woman, aged 37, was admitted to the hospital to the service of Dr. Tilney on Nov. 6, 1933, with the complaint of diminishing vision in the left eye. Nine months before admission the patient observed that vision of the left eye was poor and at the same time she had a headache over the left frontal region which was not severe. Sight of the left eye became gradually worse, and the patient became greatly perturbed because she feared that she was becoming blind.

Examination.—The patient was very emotional and complained of tingling and other peculiar sensations in all the limbs. She was greatly worried and felt that she was becoming blind and clearly had a number of functional disturbances. She mentioned only that she had some pain over the left eye when she was asked about it. There were no objective neurologic disturbances except those due to involvement of the left optic nerve.

The vision of the left eye was greatly reduced so that she could count fingers at a distance of only 1 foot. Vision in the right eye was 20/30. The visual field of the left eye was reduced to a small area in the lower nasal quadrant (fig. 1). The left disk showed the changes of primary atrophy of the optic nerve. The

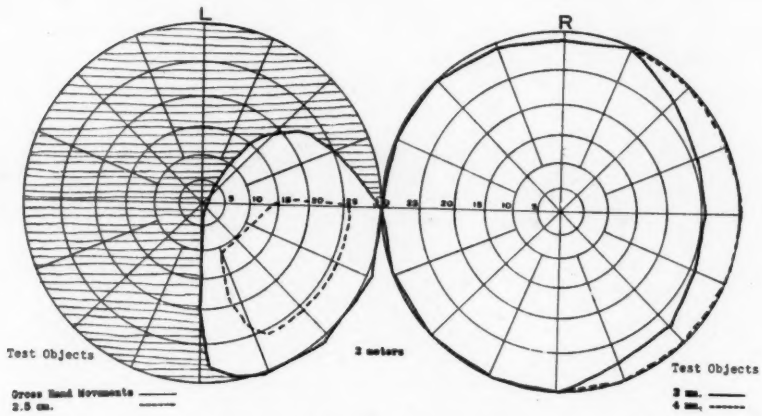

Fig. 1 (case 1).—The visual fields. On the left side, the field is limited to an area mainly in the lower nasal quadrant. The patient was able to see fingers at 1 foot (30 cm.) with the left eye. Vision in the right eye was 20/30.

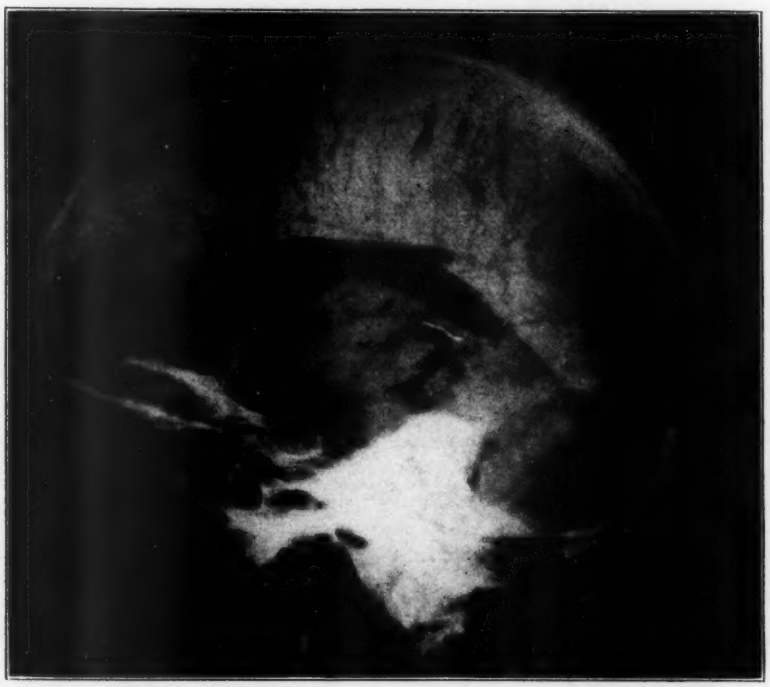

Fig. 2 (case 1).—Lateral upright encephalogram showing the left side of the cisterna interpeduncularis cut off (indicated by arrows).

right disk was normal. Roentgen examination of the skull showed that there was a slight degree of atrophy of the clinoid processes. The optic foramina were normal in size and outline.

Because of the suspicion that the patient had an intracranial neoplasm, encephalography was done. The report of the roentgen examination, made by one of us (C. G. D.), follows: "The ventricles are normal in size, shape and position. The cisterna interpeduncularis seems to be flattened in its center or even concave upward. There is a linear air shadow slightly anterior to the lamina terminalis with the concavity ventrally placed. The findings are suggestive of a meningioma arising from the tuberculum sellae" (fig. 2). On further examination the abnormal air shadow was found to be slightly to the left of the midline and indicated a tumor which lay to the left of the sella turcica.

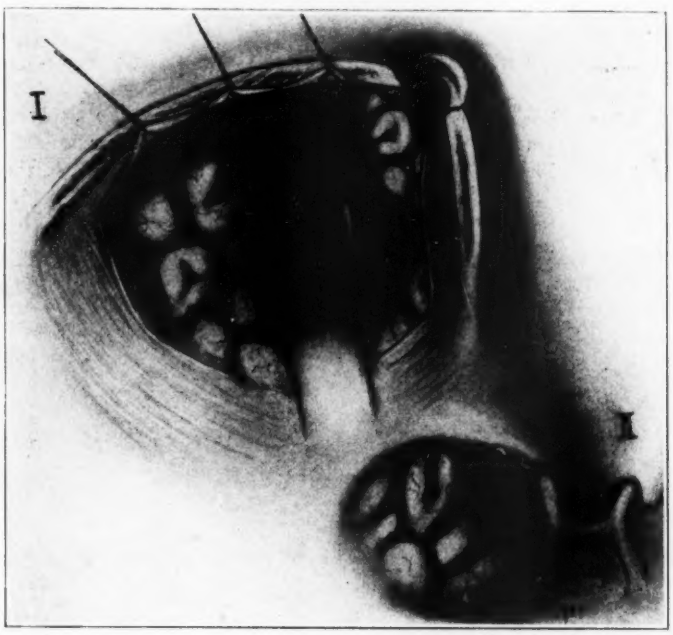

Fig. 3 (case 1).—*I*, the 1 Gm. meningioma attached to the mesial part of the left sphenoid ridge which compressed the left optic nerve at the optic foramen (elaborated from an operative sketch). *II*, the appearance after a small part of the sphenoid ridge had been rongeured away and the tumor removed.

Operation (November 29).—Under local and avertin anesthesia a left transfrontal bone flap was raised. There was not any increased tension of the dura or brain, so that after incision of the dura the left frontal lobe was retracted without difficulty and the optic nerves and chiasm exposed. The left nerve at its entry into the optic foramen was partly covered by a small neoplasm 1 by 1 by 2 cm. in size, which was attached to the most mesial part of the sphenoid ridge. The small growth was fully exposed by the removal of a small part of the sphenoid ridge (fig. 3). It had dislocated the optic nerve toward the midline and down against the margin of the optic foramen. The growth appeared to extend into the optic foramen for a few millimeters, but it was possible to separate it from the

surface of the optic nerve and to excise it in toto together with its dural attachment. It weighed little more than 1 Gm.

The patient (fig. 4) was discharged from the hospital sixteen days after the operation. At the time of her discharge the sight of the left eye was 20/50, and there was a return of vision in the upper nasal quadrant of the field (fig. 5). One

Fig. 4 (case 1).—The patient six weeks after operation, showing the scar which is hardly visible.

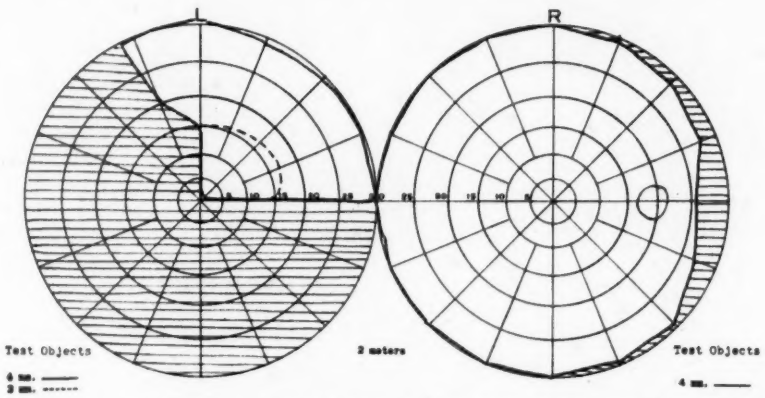

Fig. 5 (case 1).—The visual fields sixteen days after operation with an increase of vision in the upper nasal quadrant and in part of the temporal field of the left eye. Vision in the left eye was 20/70 and in the right eye, 20/20.

month later vision had improved still further, and the field was considerably enlarged (fig. 6).

Comment.—This intracranial tumor was the smallest one that had ever been removed by one of us. In its situation, in spite of its small

size, it had exerted marked pressure on the left optic nerve near the optic foramen.

CASE 2.—*History.*—C. F., aged 41, was referred by Dr. John M. Wheeler, because of progressive diminution of vision in the left eye of three years' duration. The patient's only complaint was that for three years vision of the left eye had

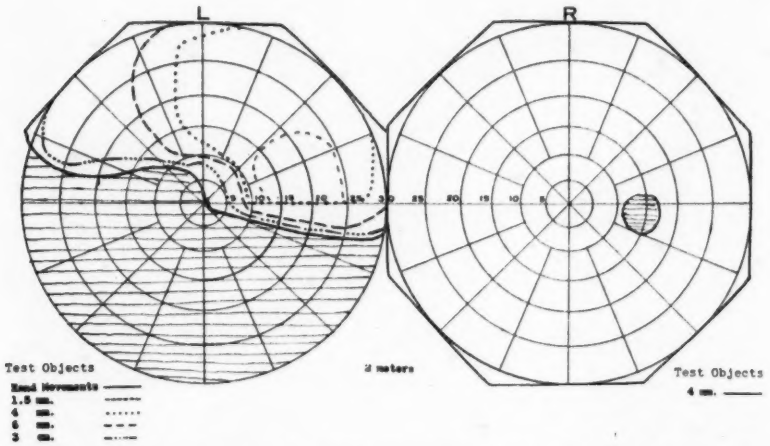

Fig. 6 (case 1).—Visual fields five weeks after the operation. Vision in the left eye was 20/50 and in the right eye, 20/35.

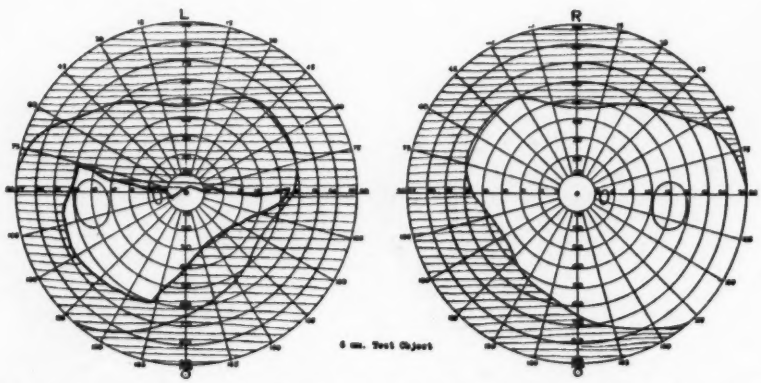

Fig. 7 (case 2).—The perimetric visual fields of the patient, taken by Dr. Wheeler.

become less. Dr. Wheeler had found a slight pallor of the left optic disk and a peculiar defect in the left visual field. During a period of observation the vision of the left eye had become less and the defect in the visual field larger (fig. 7).

Examination.—The patient was admitted to the Neurological Institute in December 1932, and examination failed to show any disturbances except those referable to the left eye. The left optic disk was pale, and the right was normal

in appearance. There was a defect in the visual field of the left eye which involved especially the upper part of the field. Roentgen films of the skull showed that the sella turcica was normal and the optic foramina of the two sides equal in size. A chromophobe adenoma of the pituitary body was suspected and the patient was discharged to receive roentgen therapy.

The visual disturbances slowly advanced, and the patient was readmitted to the hospital on Sept. 9, 1933. Examination showed that the defect in the visual field of the left eye was about the same as nine months before, but the acuity of vision was diminished, being 20/75 in the left eye and 20/20 in the right eye. The right fundus and the right visual field were normal. Roentgen examination showed that the sella turcica was slightly atrophic.

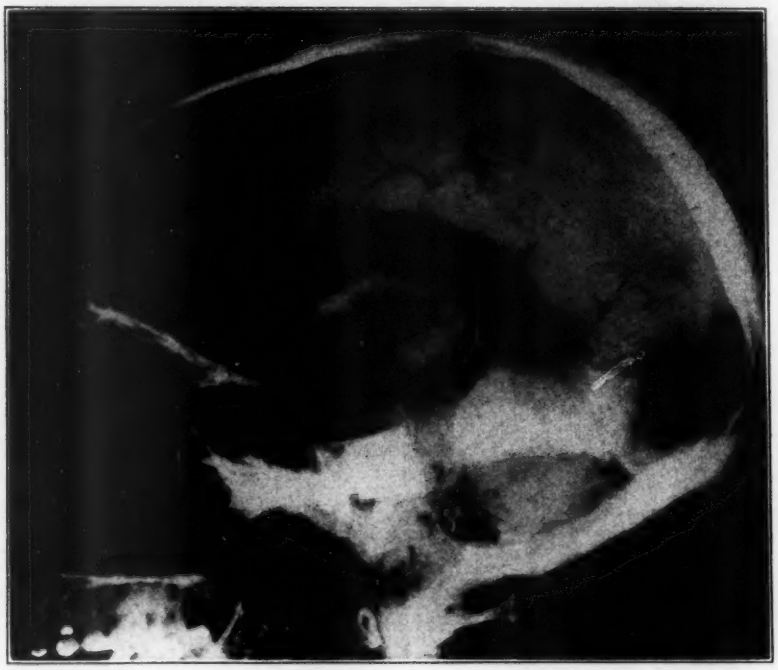

Fig. 8 (case 2).—Lateral upright view of an encephalogram showing concavity (indicated by arrows) on the rostral margin of the cisterna interpeduncularis.

As the symptoms pointed to increasing pressure on the left optic nerve, encephalograms were made. The report, made by one of us (C. G. D.), follows: "The ventricles are found to be slightly dilated. There is a concave defect on the anterior margin of the cisterna interpeduncularis slightly to the left of the midline. The defect forms a portion of a circle and measures 1.4 cm. in diameter (figs. 8 and 9). A suprasellar meningioma to the left of the midline is most likely."

After encephalography, the patient left the hospital to return three months later with a further loss of vision in the left eye. When he was readmitted on

December 4, vision in the left eye was 20/75, and in the right eye 20/20. There was now definite atrophy of the left optic disk, and the defect in the left visual field was larger (fig. 10).

Fig. 9 (case 2).—Lateral horizontal view of an encephalogram. The arrows point to the concave rostral margin of the cisterna interpeduncularis.

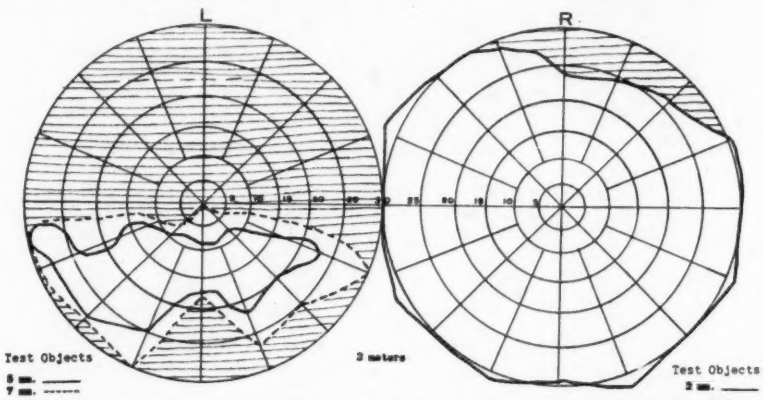

Fig. 10 (case 2).—Visual fields taken on the tangent screen about sixteen months later. The corrected vision in the left eye was 20/70 and in the right eye, 20/18.

Operation (December 8).—Under local anesthesia a left transfrontal osteoplastic flap was turned down, and a meningioma which lay to the outer side of

the optic nerve was exposed without difficulty (fig. 11). The growth was attached to the dura over the inner part of the left sphenoid ridge and partly covered the optic nerve, which was dislocated mesially. The growth was removed in fragments with the pituitary punch and the electric loop until a small fragment, perhaps 1 by 2 cm. in size, attached to the sphenoid ridge remained. During the manipulations bleeding was slight and easily controlled. At this time one of those surgical disasters occurred which unnerve even the most conscientious operator. By means of a hook the remaining tumor fragment was drawn up too forcibly by an assistant, resulting in injury to a blood vessel underneath the growth and profuse bleeding. Before the vessel could be exposed and caught, it retracted and the tension of the brain became greatly increased. The bleeding was controlled by the implantation of a piece of muscle, but the increased tension of the brain prevented further manipulations, and the wound was rapidly closed. In the ensuing

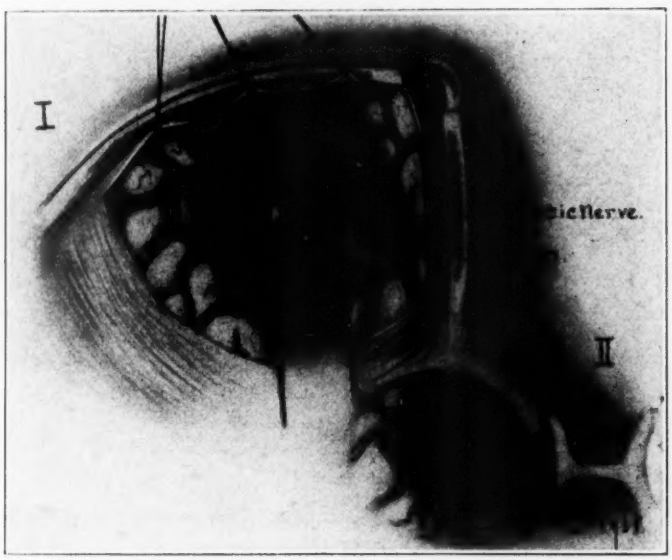

Fig. 11 (case 2).—*I*, the 8 Gm. meningioma attached to the mesial part of the left sphenoid ridge exposed at the operation. *II*, the appearance after the greater part of the tumor had been removed.

twenty-four hours the patient's condition was so poor that further operation was out of the question. He died twenty-four hours later.

Autopsy showed that there was an extravasation of blood along the base of the brain. The vessel that had been torn could not be identified with certainty; it was probably a meningeal branch from the internal carotid artery. Only a small tumor fragment attached to the sphenoid ridge remained. The left optic nerve had been markedly compressed and dislocated toward the midline.

Case 3.—*History.*—I. S., a man, aged, 48 referred by Dr. John E. Virden, was admitted to the Neurological Institute on Dec. 25, 1933, with the complaint of diminution of vision of the right eye. The patient stated that he had had an attack of pansinusitis nine years before admission, but that otherwise he had always been in good health. Two years before his admission to the hospital, the sight

of the right eye became blurred, and vision in that eye had slowly become worse. For one year he had observed that he could not see objects on the right side with his right eye. Recently he had had fleeting pain in the right supra-orbital region.

Examination.—The patient was right-handed. Except for the difficulty of vision, there were no neurologic disturbances. The pupils were equal, but the right responded sluggishly to light. The right optic disk was white and had the typical character of primary atrophy; the left disk was normal. With the right eye the patient could count fingers only at 8 inches (20.3 cm.); on the left, vision was 20/20. The perimetric examination on the tangent screen showed that there was a defect in the superior temporal part of the right visual field (fig. 12).

The report on the roentgen examination, made by one of us (C. G. D.), follows: "The tuberculum seems depressed; the posterior and the left anterior clinoid processes are normal; the right anterior clinoid process is shortened;

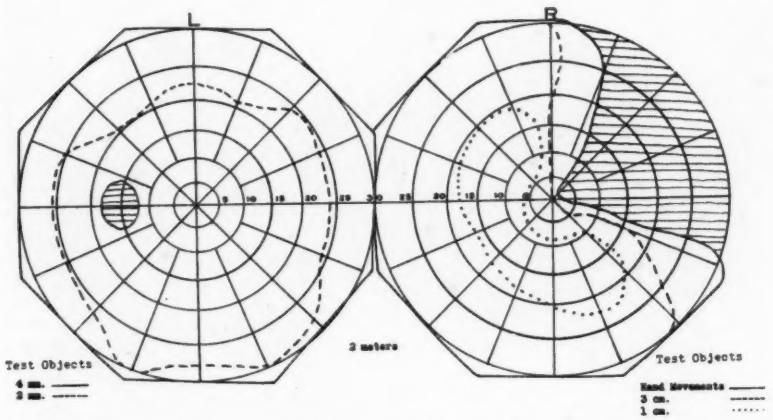

Fig. 12 (case 3).—Visual fields showing the defect on the right side. Vision in the left eye was 20/20+, and with the right eye the patient could see fingers at 8 cm.

there are a few small flecks of calcium slightly to the right of the sella. The findings suggest a suprasellar meningioma." In order to make the diagnosis certain, encephalography was done. The report follows: "The lateral ventricles are symmetrical and normal in size and position. The cisterna pontis appears normal, but the right side of the cisterna interpeduncularis appears to be displaced upward. This is at a point directly above the position of the calcified flecks. There is some air in the cisterna lamina terminals to the left of the midline, and the cisterna interpeduncularis in its center and to the right appears somewhat concave anteriorly (fig. 13). The findings strongly suggest a small tumor above the tuberculum sellae and slightly to the right of the midline."

Operation (Jan. 5, 1934).—Under local anesthesia through the usual transfrontal procedure, the chiasm and optic nerves were exposed. The right optic nerve was enlarged and gray, and the left optic nerve had a normal appearance. Lateral to the right optic nerve was a definitely enlarged internal carotid artery

which seemed dislocated upward and mesially by a small neoplasm attached to the mesial part of the sphenoid ridge (fig. 14). The neoplasm appeared so firmly attached to the undersurface of the enlarged carotid artery that its removal seemed inadvisable on account of the danger to the wall of the blood vessel.

Recovery from the operation was uneventful (fig. 15). Ten days after the operation there was a marked enlargement of the visual field of the affected eye (fig. 16) without any improvement in visual acuity.

Comment.—The small bulging mass fixed to the sphenoid ridge was very similar in appearance to what had been seen in the preceding case,

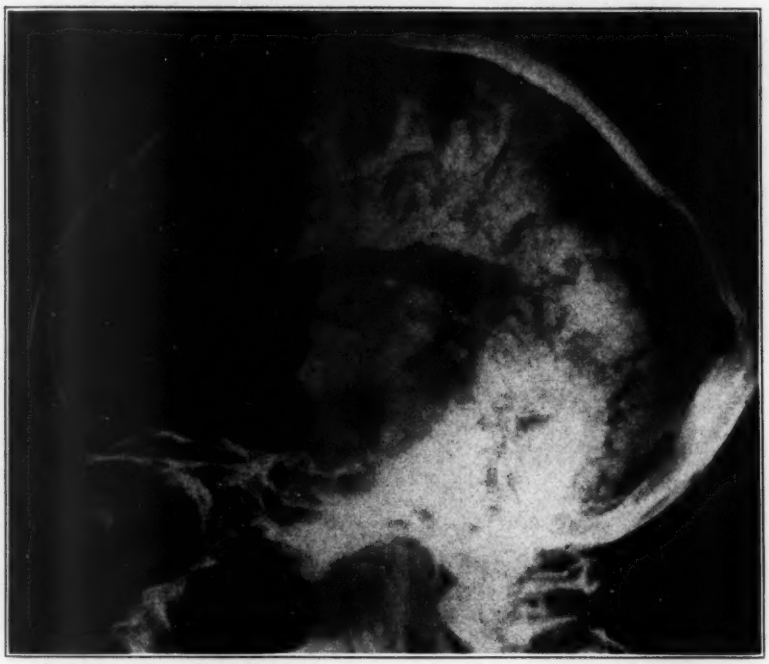

Fig. 13 (case 3).—Lateral upright encephalogram showing the dorsal displacement (indicated by arrows) of the cisterna interpeduncularis (*A*) and a defect on its ventral margin.

although the enlarged carotid artery lay over the growth, and so superficial that evidently it was dislocated upward. The connection between the enlarged artery and the growth was an intimate one so that the attempt to remove the latter seemed inadvisable because of the danger of injury to the blood vessel. The optic nerve appeared broadened and changed in color, probably also the result of the underlying neoplasm. It was hoped that the decompressive effect of the procedure would cause an improvement of vision.

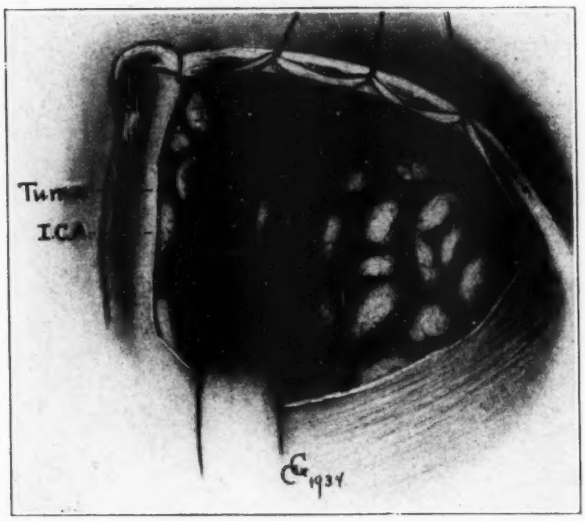

Fig. 14 (case 3).—The small neoplasm attached to the mesial part of the right sphenoid ridge exposed at the operation. *I. C. A.* indicates the internal carotid artery.

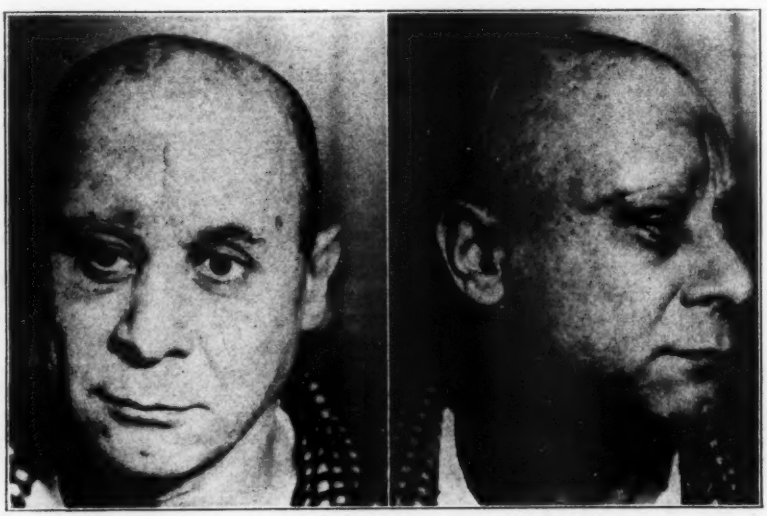

Fig. 15 (case 3).—The appearance of the scar ten days after the operation.

CASE 4.—*History.*—C. M., a contractor, aged 49, was admitted to the service of Dr. C. B. Craig, on May 14, 1934, with the complaints of headache and increasing diminution of vision of the right eye of more than four years' duration.

The patient stated that for ten years his sense of smell had been poor. In 1929, he had been struck on the right side of the forehead by a piece of wood. In January 1930, he began to suffer from pain in the right supra-orbital region. His physician found evidences of inflammation in the nasal accessory sinuses with loss of smell, and for several years he was treated for sinusitis. In 1932, the sight of the right eye became affected, and thereafter vision in that eye became steadily less up to the time of his admission to the hospital. In 1933, he had attacks of vertigo, and his wife observed that the patient's memory was becoming poor. He frequently complained of frontal headache.

Examination.—The patient was rather euphoric. Except for the changes of smell and vision, the neurologic examination gave negative results. There was

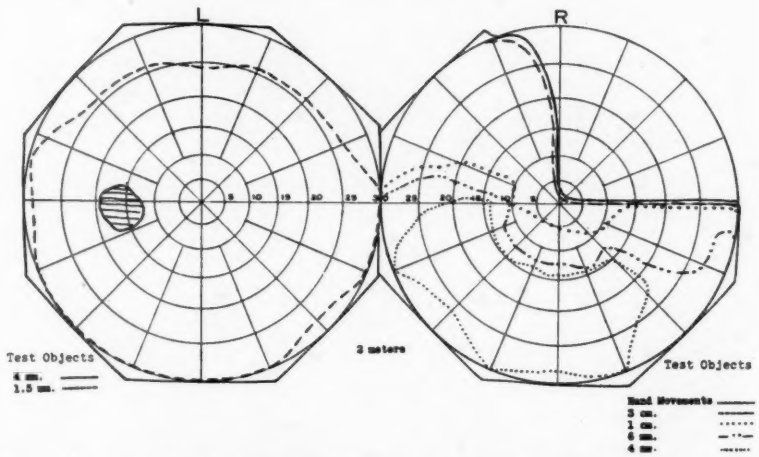

Fig. 16 (case 3).—Visual fields seventeen days after operation. Vision in the left eye was 20/30, and with the right eye the patient could see fingers at 5 feet (152 cm.).

complete anosmia, so that no odor of any kind was recognized. Vision in the left eye was 20/20; the patient could count fingers at 2 meters with the right eye. The fundus of the left eye was normal. In the right eye the nerve head was atrophic with marked pallor of the temporal portion. The field of the left eye was complete; that of the right side showed a defect mainly in the lower temporal quadrant (fig. 17).

Roentgenograms of the skull showed a slight but definite atrophy of the clinoid processes, especially on the right side. There was marked clouding of the sphenoid sinuses and the right antrum, and a small polyp was noted in the left antrum.

On account of the loss of smell, a meningioma of the olfactory groove was suspected. The patient was seen by one of us (C. A. E.) and the following opinion expressed: "It is difficult to understand that a patient with a meningi-

oma of the olfactory groove for ten years should not by this time have hyperostosis on the base and bilateral visual disturbances. It would be very unusual for such a meningioma (and most of them are operated on when they are of considerable size) to produce unilateral disturbances of vision and of the visual fields. Furthermore, there are disturbances of smell of ten years' duration, and those of vision in the right eye are of only two years' duration. I suspect strongly, therefore, that the disturbance of smell is due to an old sinus disease, and that the patient has a meningioma derived from the mesial part of the right sphenoid ridge pressing the right optic nerve toward the midline against the inner margin of the optic foramen. This would explain the unilateral atrophy of the optic nerve and the predominantly temporal defect in the visual fields. There is nothing to make one think of an aneurysm in this location, but it would be advisable to make an encephalogram in order to be absolutely sure that the unilateral disturbances of vision and the visual fields in a patient with marked sinus disease are due to a tumor."

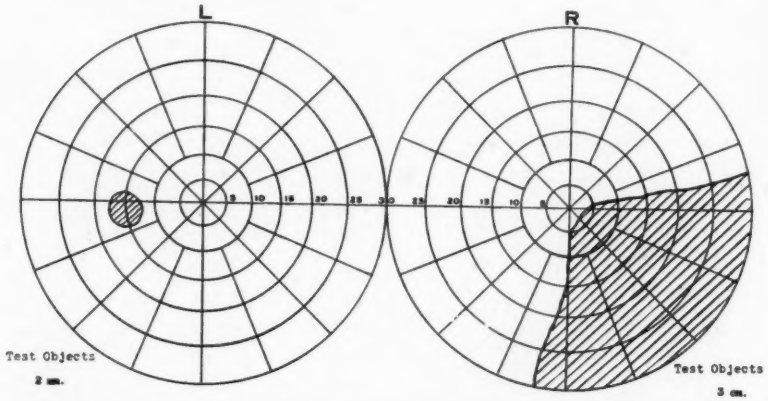

Fig. 17 (case 4).—The visual fields. On the right side there is a defect mainly in the lower temporal quadrant. Vision in the left eye was 20/20. The patient was able to count fingers at 2 meters with the right eye.

The patient refused permission for encephalography and left the hospital. He returned three weeks later on account of advance of the ocular disturbances. Encephalography was done on June 13, and the report was as follows: "The lateral ventricles are in normal position and of normal size. There is a filling defect on the inferior surface of the anterior horn of the right lateral ventricle. The left frontal horn is normal in size and outline. The callosal and cingulate sulci can be seen on the left but not on the right. The third ventricle, aqueduct and fourth ventricle appear normal. The cisternae interpeduncularis and chiasmatis appear flatter than usual. Impression: The findings strongly suggest a subfrontal tumor slightly to the right of the midline" (fig. 18).

Operation.—On June 16, under local anesthesia, a large right transfrontal craniotomy was performed. On elevation of the frontal lobe a meningioma attached to the mesial part of the sphenoid ridge was easily exposed (fig. 19). It lay above the optic nerve and internal carotid artery and was removed in fragments, except for a small piece at its attachment which was thoroughly

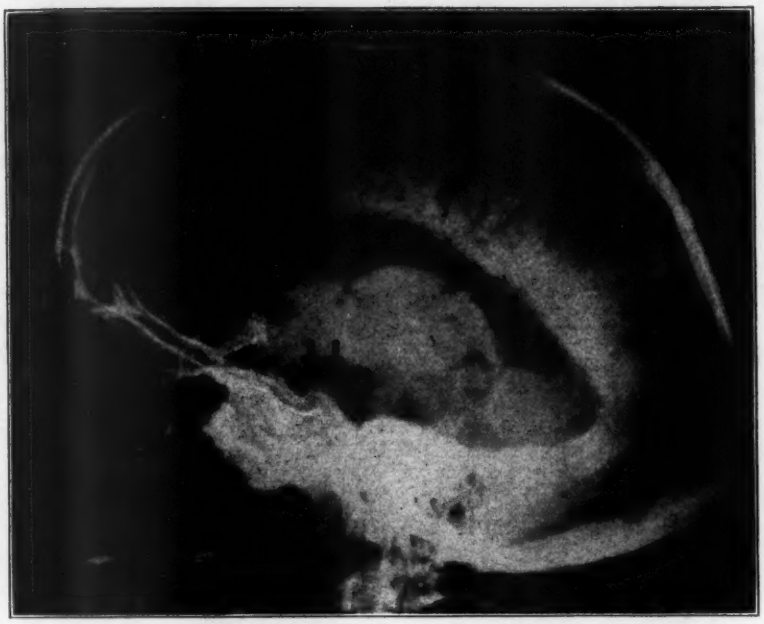

Fig. 18 (case 4).—Lateral encephalogram showing the flattening of the interpeduncular and chiasmal cisterns (indicated by arrows).

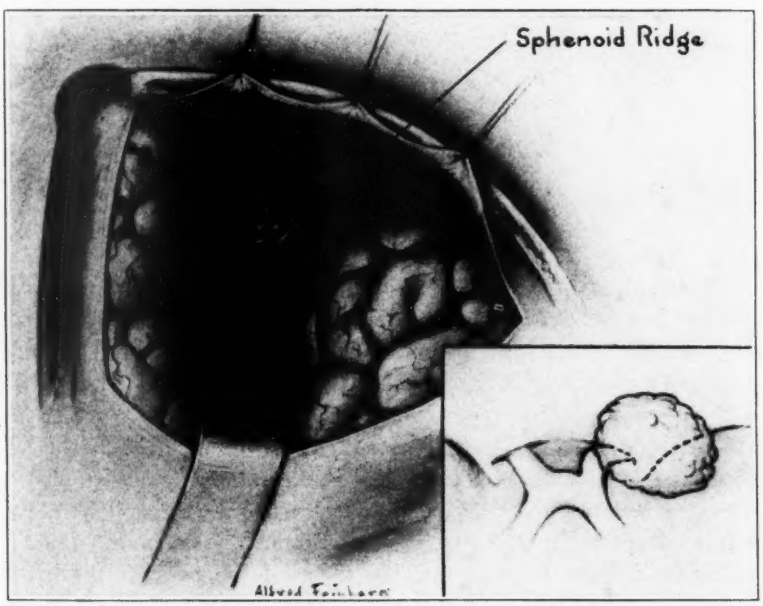

Fig. 19 (case 4).—The appearance of the meningioma exposed at operation. In the insert the location of the growth is represented diagrammatically.

charred with the electric current. The growth did not extend forward over the olfactory groove or cribriform plate. The growth measured about 3 by 3 cm. and weighed 12 Gm.

Recovery from the operation was uneventful (fig. 20).

Comment.—In this case the combination of disturbances characteristic of a meningioma attached to the mesial part of the sphenoid ridge was complicated by anosmia which was due to sinus disease. Although a growth in the olfactory groove was suspected at first, the unilateral atrophy of the optic nerve and defect in the visual field with slight atrophy of the sella turcica and alteration in the outline of the interpeduncular cistern made it possible to make a correct preoperative diagnosis.

Fig. 20 (case 4).—The appearance of the scar one week after the operation.

COMMENT

The four patients whose histories have been given were adults whose main or only complaint consisted of a slowly progressive diminution of vision in one eye. Other symptoms which usually occur in intracranial growths were conspicuous by their absence. Headache or pain in one supra-orbital region was slight or not present. Aside from atrophy of one optic disk with a defect in the visual field of the same eye, neurologic examination gave negative results.

In each instance the neoplasm was attached to the sphenoid ridge near one anterior clinoid process so that from the beginning the optic nerve was subjected to pressure. In three of the patients the growth extended over the dorsal surface of the optic nerve and the latter was dislocated toward the midline and against the underlying bone (fig. 21). In the other case the neoplasm lay underneath the optic nerve and the

internal carotid artery. In the three instances which were histologically verified the growth was a typical meningeal fibroblastoma, and the same type of tumor was probable in the other patient.

In case 1 the visual defect was in the upper half of the visual field and in the lower temporal quadrant; in case 2, mainly in the upper half

Fig. 21.—*I*, meningioma derived from the mesial part of the left sphenoid ridge overlying both carotid artery (*C*) and optic nerve. *II*, meningioma derived from the mesial part of the left sphenoid ridge lying under the carotid artery. *III*, meningioma derived from the mesial part of the left sphenoid ridge lying over the artery and under the nerve (diagrammatic). The conditions shown in *I* and *II* were seen in three patients; the condition shown in *III* may be encountered in the future.

of the visual field; in case 3, only in the upper temporal quadrant, and in case 4, in the lower temporal quadrant.

The changes in the visual fields were the result of pressure on the nerve near the optic foramen. The fact that the defects were often in the upper parts of the visual field indicated that most frequently the lowermost fibers of the nerve were affected. The course and relationship of the fibers in each optic nerve from the different quadrants of the retina are not known in detail, but in general a sector of the retina is represented by a corresponding sector of the nerve. When the upper part of the visual field is lost (superior altitudinal hemianopia of Tracquair), either the lower surface of the nerve is directly compressed by the neoplasm or that part of the nerve is pressed against the lower rim of the optic foramen. The defect is apt to extend to both sides of the vertical meridian (cases 1 and 2). With a growth which lies lateral to the nerve at the optic foramen, the first defect in the visual field may be in the upper temporal quadrant, the result of the displacement of the nerve so that its inner surface is pressed against the inner and lower margin of the optic foramen (case 3).

In three patients the defect was mainly in the upper part of the visual field, while in the fourth it was mainly in the lower temporal part of the field. A larger experience will probably show that in these tumors of the sphenoid ridge a loss of vision from pressure on the optic nerve may occur in any part of the visual field of the affected eye. The situation of the defect of the visual field is dependent on the part of the nerve which is subjected to pressure, due either directly to the neoplasm or indirectly to the dislocation of the nerve against the margin of the optic foramen.

A history of progressive diminution of vision in one eye and the discovery of primary atrophy of the optic nerve with a defect in the visual field on the affected side must lead to the suspicion that there is an increasing pressure on the optic nerve. If the roentgenograms of the skull reveal slight atrophy of the clinoid processes or the floor of the sella turcica, the diagnosis that the visual disturbances are due to a small neoplasm is probable. The diagnosis is established with certainty if a defect in the interpeduncular cistern is found on the roentgen films after the lumbar injection of air for encephalography. In one of our cases (case 2) the diagnosis was uncertain before encephalography, but in the other three the diagnosis and situation of the presumed neoplasm were suspected before roentgen studies had been made.

In all of our cases slight atrophy of the floor of the sella or of one or other clinoid process was found by the roentgenologist, but the exact situation of the neoplasm was determined from the study of roentgen films after the lumbar injection of air. The cases demonstrate the importance and value of the encephalographic studies of the basilar arachnoid cisterns which have been made in the Neurological Institute

by one of us (C. G. D.) and Davidoff. Unless the roentgenologist has a full knowledge of the normal shape, position and appearance of the basal cisterns when they are filled with air (figs. 22 and 23), slight irregularities of their outline will not be recognized and the significance of apparently trifling changes in their shape will not be appreciated. In each of our patients there was a slight but significant alteration in the outline of the cisterna interpeduncularis (figs. 2, 8, 9, 13 and 18) without any filling defect in the anterior part of the third ventricle.

Differential Diagnosis.—In adults the most frequent conditions which may produce a clinical picture similar to that of a tumor of the

Fig. 22.—Lateral upright encephalogram showing a normal interpeduncular cistern (*A*) with a straight rostral margin (indicated by arrows) formed by the tuber cinereum and optic chiasm.

sphenoid ridge are meningiomas or other benign growths which arise from the sheath of the optic nerve within the orbital cavity and aneurysms of the cavernous part of the internal carotid artery. In intra-orbital growths there would be no changes in the sella turcica and no abnormalities of the basal cisterns after encephalography. In aneurysms of the internal carotid artery there is, in most instances, homolateral involvement of the oculomotor, abducens and ophthalmic division of the trigeminal nerves resulting in more or less immobility of the eyeball and disturbances of sensibility over the forehead. Calci-

fication in the wall of the aneurysmal sac is often, but not always, visible on roentgen films of the skull.

Recently one of us operated on a patient with an aneurysm of the internal carotid artery in whom the symptoms were somewhat similar to those of a meningioma arising from the mesial part of the sphenoid ridge:

History.—H. R., aged 57, was admitted to the Neurological Institute in the service of Dr. H. A. Riley on March 30, 1934, on account of loss of vision in the left eye. In September 1932, she had suffered from a herpetic eruption on the

Fig. 23.——Lateral horizontal encephalogram showing the cisterna interpeduncularis (*A*) and the cisterna chiasmatis (*B*) with the optic chiasm interposed.

left cheek for two weeks. From the description given by the patient, the herpes had been limited to the area of distribution of the maxillary branch of the left trigeminal nerve. In March 1933, the lids of the left eye became swollen, the swelling lasting for about ten days. This swelling of the left eyelids had recurred several times. In the summer of 1933, there was a diminution of vision of the left eye. This gradually progressed so that by March 1934, the sight of the left eye was lost. At times the patient had a tingling sensation in the left cheek. In December 1933, she had another attack of herpes on the left cheek. She had never had headache, and aside from the disturbances described had been in good health.

Examination.—The patient was a very intelligent woman who did not look ill. Aside from the visual defect there were no neurologic disturbances. Sensation of the left side of the face was normal. The movements of the eyeballs were good in all directions. The left pupil was moderately dilated and did not react to light; the right reacted promptly. Vision in the right eye was 0; in the left eye, 20/30. The field of the right eye was complete (fig. 24) though perhaps slightly contracted. The left fundus showed the changes of advanced primary atrophy of the optic nerve; the right fundus was normal. Auscultation of the skull failed to demonstrate a bruit.

Laboratory examinations, including Wassermann tests of the blood and spinal fluid, gave negative results.

The roentgen examination of the skull did not show evidences of increased intracranial pressure, and the sella turcica was normal. After an injection of air for encephalography, roentgen examination, made by one of us (C. G. D.), showed the following: "The lateral ventricles are normal in size, shape and

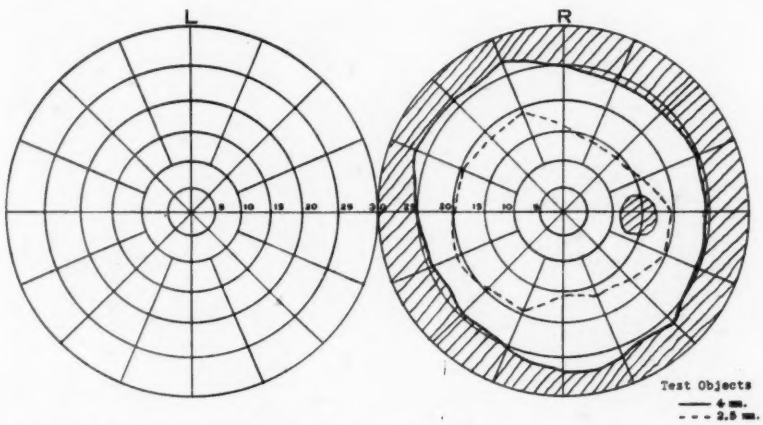

Fig. 24.—Visual fields showing loss of all vision in the left eye from an aneurysm of the internal carotid artery which lay against the mesial part of the left sphenoid ridge. Vision in the left eye was 0, and in the right eye, 20/30. There was no perception of light in the left eye.

position. The third ventricle, the aqueduct and the fourth ventricle contain air and are of normal size. The basal cisterns do not appear unusual in size, but the cisterna chiasmatis does not fill with air and the anterior part of the cisterna interpeduncularis is not satisfactorily filled (fig. 25). Impression: The absence of air in the cisterna chiasmatis and the incomplete filling of the anterior portion of the cisterna interpeduncularis are compatible with a small tumor involving the region of the chiasm. The filling defect of the interpeduncular cistern is more on the left side."

The patient was transferred to the surgical service and transfrontal craniotomy was performed on the left side under local anesthesia on April 19. The region of the chiasm and left optic nerve was easily exposed. The mesial part of the sphenoid ridge was occupied by a small tumor about 2 by 2 cm. in size, which compressed the left optic nerve near the optic foramen. The surface

of the mass was smooth and did not have the appearance ordinarily presented by a meningioma (fig. 26). The tumor was punctured with a fine hypodermic needle and bright red blood withdrawn. The pressure within the mass, which was evidently an aneurysmal sac, was so great that blood spurted out alongside the needle. After the latter had been withdrawn, the bleeding from the small puncture hole in the aneurysm was controlled with some difficulty by the application of a piece of muscle. The dural incision was closed by suture and the bone flap returned into place.

Convalescence from the operation was without incident (fig. 27). Ten days after the operation the patient was taught to make digital compression on the

Fig. 25.—Lateral upright encephalogram showing a concave defect, indicated by arrows, in the rostral part of the cisterna interpeduncularis which lay slightly to the left of the midline. The case was one of aneurysm of the left internal carotid artery. (See figures 24, 26 and 27.)

left common carotid artery, and she has continued to make daily pressure on the vessel for increasingly long periods. After several months, it is our intent to ligate the left common carotid artery.

Comment.—On account of the history of herpes and of attacks of swelling of the eyelids, we had seriously considered the possibility of aneurysm and, therefore, it did not occasion surprise when a vascular lesion was disclosed at the operation. The aneurysm was situated in

the same part of the sphenoid ridge as the meningiomas we have described; it compressed only the left optic nerve and was not large enough to have affected the chiasm or the motor oculi nerve. The

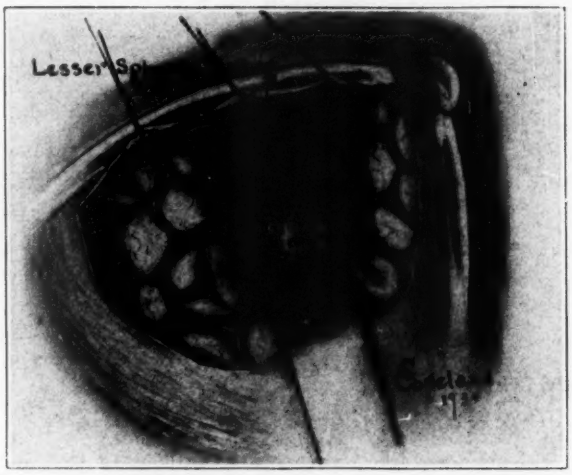

Fig. 26.—The aneurysm exposed at operation in the patient whose fields are illustrated in figure 24.

Fig. 27.—The scar of the transfrontal craniotomy ten days after the operation.

symptoms were similar to those found with meningiomas attached to the mesial part of the sphenoid ridge, but the attacks of swelling of the eyelids and of herpes on the cheek were unusual for a meningeal growth and made one think of a lesion involving the cavernous sinus.

It would have been valuable if examinations of the left visual field had been made before the patient came under our observation and before all vision of that eye was lost.

The case demonstrates that unilateral loss of sight with practically normal vision and visual fields of the other eye may occur in the early stages of aneurysm of the anterior part of the internal carotid artery near the optic foramen.

Unilateral diminution of vision with a defect in the visual field of the affected eye is occasionally observed in other intracranial conditions in which the conduction interference in the optic nerve depends on local pressure. Thus it might be found in the early stages of inflammatory processes of the leptomeninges around the optic nerves and chiasm (cisternal arachnoiditis). In our experience, however, the

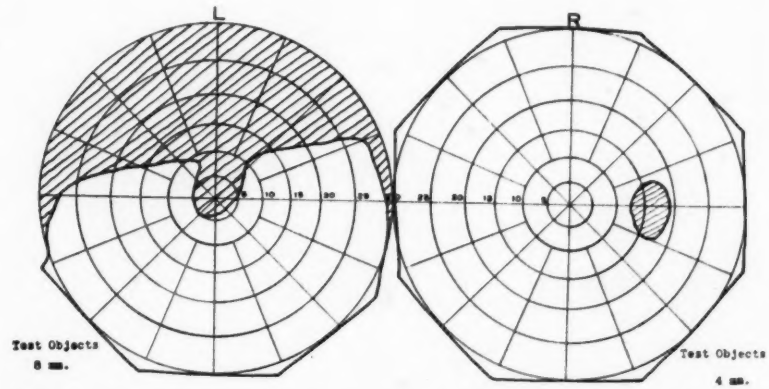

Fig. 28.—The defect in the upper part of the left visual field in a patient with craniostenosis and narrowing of the left optic foramen.

atrophic changes in the fundi and the defects of the visual fields in these patients are usually bilateral. We have recently seen and operated on a patient who had a unilateral defect of the visual field and atrophy of the optic nerve on one side (fig. 28) due to craniostenosis (fig. 29) with marked narrowing of one optic foramen as the result of the bony maldevelopment. In this patient, however, the roentgen films of the skull showed the characteristic changes of craniostenosis, the sella turcica was not atrophied, and encephalography (fig. 30) demonstrated that the interpeduncular cistern was normal in size and outline.

The surgical approach to the meningiomas attached to the mesial part of the sphenoid ridge must always be made on the side of the affected optic nerve. In operations for tumors which arise from the tuberculum sellae and which lie predominantly in the midline, the growth may be adequately exposed and removed through an approach from either

Fig. 29.—Lateral roentgenogram of the skull showing the characteristic changes in craniostenosis.

Fig. 30.—Lateral encephalogram of the case illustrated in figures 28 and 29 showing a normal interpeduncular cistern.

side. As most surgeons are right-handed and because in righthanded patients the speech centers are situated in the left cerebral hemisphere, the preference has usually been to expose the growth by a transfrontal procedure on the right side. In the meningiomas which arise from the mesial part of the sphenoid ridge, however, no choice is possible, and the surgical approach must be made on the side of the affected optic nerve.

SUMMARY

Four cases are described of tumors attached to the most mesial part of the sphenoid ridge which produced a characteristic combination of disturbances. The syndrome of unilateral atrophy of the optic nerve with a defect of the visual field on the same side, with slight roentgen changes of the sella turcica and alterations in the shape of the interpeduncular cistern, is characteristic of tumors in this situation. The early recognition of the significance of this syndrome will make it possible to remove the growths when they are of small size.

DISCUSSION

DR. CORNELIUS G. DYKE: For the past four years at the Neurological Institute, Dr. Leo M. Davidoff and I have made a study of the various cerebral structures as seen in the encephalogram. This study has made it possible to recognize many of the convolutions, sulci, nerves and blood vessels in the encephalograms and to determine whether the structures are normal or abnormal.

The basal cisterns are a group of intercommunicating subarachnoid spaces, filled with fluid, adjacent to the brain. The fluid can be withdrawn from these cisterns by lumbar puncture and replaced with air, thereby making these spaces and the contiguous structures visible in the roentgenogram.

In this discussion, the cisternae interpeduncularis and chiasmatis are of importance, since it is these structures which are affected by the small tumors occurring in the vicinity of the optic chiasm. The former is somewhat rectangular, the cephalic border being formed by the tuber cinereum and infundibulum; the caudal boundary, by the belly of the pons. The shorter ventral boundary is formed by the caudal part of the diaphragm sellae and the dorsum sellae, while the dorsal short border is formed by the cerebral peduncles. The rostral border of this cistern when viewed in profile forms a straight line.

The cisterna chiasmatis is situated chiefly ventral to the chiasm and between the optic nerves. It is shaped somewhat like an inverted comma, and when well filled with air the optic chiasm can be seen.

Adenomas of the pituitary body, when they have grown beyond the confines of the sella turcica, displace the cisterna interpeduncularis dorsally and produce a concavity in its ventral border. The cisterna chiasmatis is often displaced rostrally and dorsally by this type of tumor.

Meningiomas arising from the medial part of the sphenoid ridge produce a defect in the rostral border of the cisterna interpeduncularis. In the extremely small tumors, such as Dr. Elsberg has described, only one side of the cistern may have a concave defect in it. The larger tumors cause a more definite defect in one side of the rostral margin of the cistern, and the more medial part of the cistern may be deformed. The smaller meningiomas arising at the base of

an anterior clinoid process or at the tuberculum sellae often prevent complete filling of the cisterna chiasmatis in addition to the deformity of the interpeduncular cistern.

Another lesion, as Dr. Elsberg has mentioned, which may produce a deformity of the cisternae chiasmatis and interpeduncularis, is an aneurysm of the internal carotid artery or anterior portion of the circle of Willis. The deformity of the cisterns produced by this type of lesion cannot be differentiated from that produced by a true neoplasm.

In conclusion, the diagnosis of these small tumors depends on a careful study of the basal cisterns and the noting of any small deformity in them. When there is an absence of one or both of these cisterns, the evidence is suggestive, but not conclusive, of a tumor.

[Slides were shown demonstrating the normal appearance of the cisternae chiasmatis and interpeduncularis and deformities in them as a result of tumor.]

DR. JOHN M. WHEELER: We are grateful to Dr. Elsberg for the first report on this interesting syndrome, a syndrome of great importance to ophthalmologists. I think that one should carry away a definite picture of the lesion: a meningioma at one anterior clinoid process, attached to the lesser wing of the sphenoid, close to the optic nerve, and the signs and symptoms that this meningioma produces.

Dr. Elsberg has asked me to say a word about case 2, the one that I was especially interested in in this group of three. This patient came to me with entirely undramatic symptoms. He said that he had the sensation that he was doing most of his seeing with his right eye; in other words, there was an indefinite impression that his left eye was not doing its duty. Examination revealed atrophy of the optic nerve which was primary, and I made the note at the time that it might well be due to pressure. He said that his stomach was easily upset, and that perhaps once a month he ate or drank too much and was nauseated and that at such times he had a little headache on the left side. That is all he had to offer in the way of symptoms. I have the charts of the visual fields here. From only three cases probably one should not try to say what is characteristic in the way of defects in the visual fields, but I think that one can get a fair mental picture of the defects that may occur. This is a unilateral lesion, and there is a unilateral injury to the field. The upper part of the field was practically gone at an early examination. Part of the lower field and part of the field all around are gone on the left side. After a period of therapeutic roentgen treatments the field of vision in the left eye enlarged and is represented in the chart. The enlargement took place between Nov. 1, 1932, and March 6, 1933. Later, there was progressive loss of the visual field. In this case the central vision was not badly damaged. When the patient first came to me complaining of the left eye failing to do its duty, the vision was 20/20 minus with correction. Only a short time before operation the vision was 20/40 minus with correction. Before operation it had failed to 20/70 with correction.

I think that it would be interesting if Dr. Elsberg would tell something of what might happen in these cases. In my case an unfortunate accident occurred which resulted in the death of the patient. But suppose that the tumor had been entirely and successfully removed, Dr. Elsberg, what would have happened to the field? Would it have enlarged? Would the patient's vision have improved? Suppose that a part of the tumor had been left behind; suppose that the tumor had escaped entire removal. Would the growth have been much more rapid as a result of the operation? Would it have metastasized? Suppose that the patient had not been operated on, but had had more roentgen therapy, would further benefit

have occurred? Suppose that the diagnosis had not been made and the patient had had no treatment, what would have happened?

DR. THOMAS H. JOHNSON: Painstaking and searching investigation may fail to reveal the cause of a unilateral atrophy of the optic nerve, and to interpret the meaning of such an atrophy is often a baffling problem.

As shown by Dr. Elsberg, an intracranial tumor may press on the optic nerve, causing visual disturbance with few or no other neurologic signs.

I have had a case recently which in its early stage evidently presented the syndrome described by Dr. Elsberg. A business woman, aged 41, the mother of four small children, came to see me on Jan. 23, 1934. She gave the following history: Seven years previously the vision in the right eye began to fail. She saw a competent oculist who told her that she had trouble with the optic nerve and that little could be done for the eye. For two years the right eye had been more prominent than the left. Examination showed the following changes in the right eye: The eye was proptosed slightly downward, and the pupil was dilated and did not react to direct light but reacted consensually left to right. There was no perception of light, and the optic nerve was white. Movement of the eyeball was not limited.

An exophthalmometer reading was: right eye, 22.5 mm.; left eye, 17 mm.

I sent the patient to Dr. Raymond Pfeiffer for a roentgen examination, and he made the following report:

"Films of the orbits show well defined asymmetry of the walls, the right showing marked increase in density of portions of the medial and lateral walls and of the roof. The lesser wing of the sphenoid is involved in its entirety by hyperostosis which stops at the suture and does not invade the orbital plate of the frontal bone. The sphenoid ridge in the third adjacent to the sella turcica is markedly irregular with spicules projecting inwardly, revealing the site of the origin of the tumor. The hyperostosis then descends into the lateral wall involving all of that portion of the greater wing of the sphenoid. Immediately above the junction of the sphenoid ridge with the vault there is located a line of decreased density which appears more like a fracture than a vascular channel. The involvement of the middle fossa extends below and posteriorly for approximately 2 cm. The right side of the body of the sphenoid, at the root of the lesser wing, also shows the thickening process. The superior orbital fissure and the optic canal are entirely surrounded by tumor and bone involved by tumor. The optic canal has lost its normal appearance and seems to be joined with the fissure. The margins of the canal are soft and suggest the encroachment of the neoplasm into the lumen, revealing the cause of the optic atrophy. The left orbit is entirely normal and the margins of the orbits are symmetrical. The sella turcica is normal.

"Impression: meningeal fibroblastoma of the right sphenoid ridge infiltrating the entire right side of the sphenoid bone."

I then sent the patient to Dr. Clement B. Masson, who, on February 7, removed a fibroblastoma from the right middle fossa. The patient has made a complete recovery except for exophthalmos and blindness of the right eye and is again happily at work.

The tumor had pressed on and flattened the intracranial part of the optic nerve, causing atrophy.

One is struck by the absence of symptoms, other than in the eye, in patients with tumors in this location. This patient had no headache, pain, vomiting, muscular weakness or dizziness. She came to me because of the increasing prominence in the affected eye.

It should not be necessary to stress the importance of roentgen studies in cases presenting atrophy of the optic nerve in one eye. Meningeal fibroblastomas develop in contact with the bony structures and lead to changes in the bones that are easily demonstrated by roentgenogram, and roentgen studies repeated at intervals of a few months should lead to a diagnosis of intracranial neoplasm.

Exophthalmos does not ensue until the tumor has extended to and involved the bony walls of the orbit and is a late manifestation.

Of course, a thorough neurologic study of cases with unilateral atrophy of the optic nerve should be made.

I believe that in a case of an unexplained unilateral atrophy an encephalogram is justified.

DR. CHARLES A. ELSBERG: Dr. Wheeler has asked questions which are difficult to answer unless one wants to speak at length. His first question was, "If the tumors are successfully removed, would the visual fields become enlarged?" The postoperative fields of the patients who survived show that in some instances there was a steady enlargement in the visual fields. It is well to remember, however, that in the case of a large tumor which has pressed on one optic nerve for a considerable period, the vision in that eye may not improve after the complete removal of the tumor, while the vision in the other eye returns to normal. In these large tumors both eyes are usually involved, but if for a long period vision has been lost in one eye, sight on the side of the tumor is not usually regained.

The second question asked by Dr. Wheeler was this: "If part of the growth only had been removed, would the remainder have increased in size more rapidly?" I think I can answer this by saying no. These tumors continue to grow slowly if only part can be removed except when the tumor is not a true meningioma, but is a meningeal sarcoma. These tumors never cause metastases.

In answer to the third question as to whether further roentgen treatment would have done good, I doubt it. In our entire experience we have seen only three patients whose vision was only temporarily improved by roentgen treatment, and in these instances in which the delay was due to one cause or another, and roentgen treatment was given, the growths were found to be large when the operation was performed, and the difficulties of removal of the growth were greatly increased. In fact, in each instance I regretted that the patient had not been operated on earlier.

If nothing had been done the patient might have gone on for a number of years, but sooner or later the second eye would have been affected, the tumor would have been large, and there would have been bony changes in the base of the skull. These bony changes are sometimes marked, as in the case mentioned by Dr. Johnson, and they may produce symptoms even after the intradural growth has been removed. The hyperostosis is on the base and can seldom be radically removed, and there is tumor tissue in the bone. Therefore, if nothing had been done in the case of Dr. Wheeler, one finally would have had to deal with a large meningioma, and possibly only part of the tumor could have been removed. The visual disturbances might have involved both eyes. The outcome in this case was unfortunate.

ETIOLOGIC DIAGNOSIS OF CONJUNCTIVITIS

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Unlike other mucous membranes of the body, the conjunctiva has a limited normal bacterial flora, the only two constant inhabitants being Corynebacterium xerosis and Staphylococcus epidermidis albus, both of which are saprophytes. The mechanical cleansing action of the tears as well as their lysozyme content acts to eliminate accidental contaminants, usually bacteria from the air, as well as to inhibit the normal conjunctival flora. In the presence of acute or subacute conjunctivitis the saprophytes are often crowded out by the invading micro-organisms to such an extent that in films of secretions or scrapings of epithelium the exciting agent is found in pure or almost pure culture. This feature renders the diagnosis of conjunctivitis, by a study of films, practical and often simple.

IMPORTANCE OF AN ETIOLOGIC DIAGNOSIS

The determination of the etiology, when possible, is a fundamental principle of scientific medicine. The importance of knowing the active microbic agent in conjunctivitis is obvious for epidemiologic, diagnostic and prognostic purposes, and proper management is often possible only when the etiology is known. In the stress of private and clinical practice, however, a bacteriologic diagnosis is often neglected. I purpose in this paper, therefore, to offer a technic adequate for diagnostic purposes but simple enough to require a minimum amount of time and effort. The film technic is designed particularly for the ophthalmologist in private practice, while the combined film and culture technic is designed for the clinic.

FILM TECHNIC

Materials Required.—Two stains are necessary. The Gram stain gives all information needed in conjunctivitis of bacterial origin. The Giemsa stain gives the information required in trachoma and in inclusion conjunctivitis (inclusion blennorrhea and swimming pool conjunctivitis), and also enables the detection of eosinophils present in vernal catarrh.

From the Department of Ophthalmology, College of Medicine, State University of Iowa.

Read in the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 15, 1934.

Gram Stain: Of the many modifications of the Gram stain, the Hucker modification [1] has been found satisfactory. For this the following preparations are needed:

Ammonium Oxalate-Crystal Violet Solution

Solution A

Crystal violet (85 per cent dye content)	4	Gm.
Ethyl alcohol (95 per cent)	20	cc.

Solution B

Ammonium oxalate	0.8	Gm.
Water	80	cc.

Mix solutions A and B.

Compound Solution of Iodine

Iodine	1	Gm.
Potassium iodide	2	Gm.
Water	300	cc.

Counterstain

Safranine (saturated solution in 95 per cent alcohol)	10	cc.
Water	100	cc.

Stain the films for one minute with the crystal violet solution. Wash in water. Immerse in the iodine solution for one minute. Wash in water and blot dry. Decolorize in 95 per cent alcohol for thirty seconds with gentle agitation. Cover with the counterstain for ten seconds. Then wash, dry and examine.

Giemsa Stain: Allow the films to dry in air not longer than five minutes. Fix in chemically pure (acetone-free) methyl alcohol for two hours or longer. Transfer to a dilute Giemsa staining fluid (1 drop to 2 cc. of neutral distilled water) and stain for one hour or longer. Decolorize for five seconds in each of two changes of 95 per cent ethyl alcohol. Dry in air.

If rapid diagnosis is required, the following technic may be used: Fix for one minute with the May-Greenwald stain. Dilute the fixative with an equal number of drops of neutral distilled water and allow the solution to remain on the film for four minutes. Transfer to a dilute Giemsa staining fluid and stain for fifteen minutes or longer. Decolorize in alcohol. Dry in air.

Method.—Make four preparations from each case, two epithelial scrapings and two secretion films. Place one epithelial scraping and one secretion smear in absolute methyl alcohol. Stain the secretion film by the Gram method. If it gives satisfactory information, discard the other slides.

CULTURE TECHNIC

Mediums.—Blood agar plates are used as a routine. Loeffler's blood serum slants, chocolate agar and ascitic fluid blood agar should be available.

Method.—Cultures are taken most satisfactorily from the lower culdesac, with care to avoid the lashes and lid margin. In chronic blepharoconjunctivitis, cultures are taken also from the lid margins and the inner canthus. The cultures are incubated at 37 C.

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1. McClung, C. E.: Handbook of Microscopical Technique, New York, Paul B. Hoeber, Inc., 1929, p. 93.

THE CONJUNCTIVAL BACTERIA

The morphologic and biologic characteristics, the determination of which is essential for the recognition of the conjunctival bacteria, are outlined in tables 1 and 2. Other characteristics are as follows:

Saprophytes.—Corynebacterium xerosis (the xerosis bacillus) is often found in large numbers on degenerated epithelial cells. Colonies on blood agar are characteristically small, grayish white, dry, granular and slow-growing. Barred and granular forms of the bacterium usually occur in specimens from culture but are often absent in direct smears.

Corynebacterium Hoffmanni (Hoffmann's bacillus) is typically shorter and fatter than the xerosis bacillus. It is not barred or granular. Colonies on blood agar are large, opaque and granular.

Staphylococcus epidermidis (Staphylococcus albus) occurs in large, china-white colonies. It does not show hemolysis.

Sarcina is an air bacterium, the colonies of which are large, granular and usually pigmented.

Pathogens.—Neisseria gonorrhoeae (Gonococcus) may be recognized by the finding of gram-negative diplococci on living epithelial cells.

Haemophilus conjunctivitidis (Koch-Weeks' bacillus) produces typically an acute conjunctivitis with marked bulbar injection. Epithelial scrapings usually show a turflike arrangement of the bacteria on the cells. The essential morphologic characteristics are minute size and slender bacillary shape.

Haemophilus influenzae (the influenza bacillus) produces typically a subacute conjunctivitis with bulbar injection. Secretion films show minute coccobacilli, often paired, occasionally in short chains. Some individual organisms, except for their reaction to the Gram stain, could be confused with small pneumococci. The cultural characteristics are identical with those of the Koch-Weeks bacillus, and study of their morphologic characteristics in direct smears is the only means of distinguishing between the two micro-organisms.

Many bacteriologists [2] believe that H. conjunctivitidis and H. influenzae are identical. The morphologic differences between them, however, though lost in culture, are striking in direct preparations from secretions. On the basis of this differentiation, one concludes that H. conjunctivitidis produces typically an acute conjunctivitis while H. influenzae is almost invariably associated with a subacute disease. In support of this conclusion, and indicating that the geographic distribution of the two bacteria is not the same, it has been observed in Iowa City that cases of mild conjunctivitis are associated with influenzal infections of the nose and throat, while severe infections are almost invariably pneumococcic. Koch-Weeks' conjunctivitis, according to these diagnostic methods, is almost never seen.

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2. Durand, P., and Lumbroso, U.: Recherches sur le bacille de Weeks, Arch. Inst. Pasteur de Tunis **15**:71 (June) 1926.

Diplococcus pneumoniae (Pneumococcus) obtained from the conjunctiva does not generally permit the demonstration of capsules.

TABLE 1.—*Differentiation by Culture of the Common Conjunctival Bacteria*

- **Cocci**
  - **Gram-positive**
    - **Clusters—Staphylococcus**
      - Gelatin liquefied; golden pigment; beta hemolysis frequent; pathogenic—Staphylococcus aureus
      - Same, except no pigment—Staphylococcus albus
      - Gelatin slowly liquefied; no pigment; no hemolysis; nonpathogenic—Staphylococcus epidermis-albus
    - **Chains**
      - Blister-like colony with central depression; alpha (green) hemolysis; bile-soluble; ferments inulin—Diplococcus pneumoniae
      - Minute colony with opaque heaped-up center; insoluble in bile; does not ferment inulin
        - Beta hemolysis—Streptococcus haemolyticus
        - Alpha hemolysis—Streptococcus viridans
        - No hemolysis—Streptococcus nonhaemolyticus
    - **Packets—Sarcina**
  - **Gram-negative**
    - Scanty or no growth on plain mediums; good growth on ascitic fluid blood agar; ferments dextrose, not maltose; grayish opalescent colony—Neisseria gonorrhoeae
    - Good growth on dextrose blood agar or chocolate agar; ferments dextrose and maltose—Neisseria meningitidis
    - Good growth on plain agar; does not ferment dextrose or maltose—Neisseria catarrhalis
- **Rods**
  - **Gram-positive**
    - **Spores formed; aerobic bacillus**
      - Usually beta hemolysis; raised opaque colony with curled edge; nonpathogenic for animals—Bacillus subtilis
    - **Spores not formed; aerobic**
      - Acid-Fast—Myco. tuberculosis
      - **Not acid-fast—Corynebacterium**
        - Long and slender; clubbed ends; metachromatic granules; pathogenic; ferments dextrose and dextrin, not saccharose—Corynebacterium diphtheriae
        - Similar morphology; nonpathogenic; ferments dextrose and saccharose, not dextrin—Corynebacterium xerosis
        - Short; not granular; nonpathogenic; does not ferment saccharose, dextrin or dextrose—Corynebacterium Hoffmanni
  - **Gram-negative**
    - **Growth on plain mediums; gelatin not liquefied; acid and gas with lactose**
      - Acid and gas with dextrose, lactose and dulcite, not saccharose—Escherichia coli
      - Acid and gas with dextrose, lactose and saccharose—Klebsiella pneumoniae (Friedländer)
    - **Enriched mediums required (hemoglobin)—Haemophilus**
      - Scanty growth on blood agar; abundant growth on chocolate agar—Haemophilus influenzae; Haemophilus conjunctividis (Koch-Weeks)
      - Large diplobacillus; liquefies blood serum; no growth on plain agar—Haemophilus lacunatus (Diplobacillus of Morax)

Saprophytic forms are usually not bile-soluble, but this property can be readily restored by passage through mice.

Streptococcus haemolyticus rarely produces a catarrhal conjunctivitis and exhibits no affinity for the conjunctical epithelium. It is

probably the cause of the majority of the cases of chronic pseudomembranous conjunctivitis which are not diphtheritic. The streptococcic type is really a subconjunctivitis, and the bacteria are usually demonstrable only when the epithelium is broken.[3]

Corynebacterium diphtheriae (the diphtheria bacillus) produces typically a pseudomembranous conjunctivitis. Scrapings for direct microscopic examination and for culture should be taken after removal of a portion of the membrane. It may be recognized by the finding of pleomorphic gram-positive rods on living epithelial cells. Colonies may be obtained by culture on Loeffler's blood serum medium in from twelve to eighteen hours.

TABLE 2.—*Differentiation by Morphology of the Common Conjunctival Bacteria*

Cocci	Gram-positive	Clumps or pairs; pleomorphic; never on living epithelial cells—Staphylococcus
		Pairs or short chains—Streptococcus
		Lancet-shaped diplococci—Diplococcus pneumoniae
	Gram-negative	Kidney-shaped diplococcus; growth on living epithelial cells—Neisseria gonorrhoeae
Rods	Gram-positive	Pleomorphic; clubbed ends; growth on living epithelial cells—Corynebacterium diphtheriae
		Similar morphology; no growth on living epithelial cells—Corynebacterium xerosis
	Gram-negative	Encapsulated—Klebsiella pneumoniae (Friedländer)
		Large diplobacillus—Haemophilus lacunatus (diplobacillus of Morax)
		Minute coccobacillus—Haemophilus influenzae
		Minute slender rod—Haemophilus conjunctivitidis (Koch-Weeks)

Staphylococcus aureus is a common cause of subacute conjunctivitis in the new-born and of chronic conjunctivitis in the adult. Pathogenic strains generally show wide areas of beta (clear) hemolysis on blood agar. Strains vary widely in the amount of pigment produced.

Haemophilus lacunatus (the diplobacillus of Morax) produces typically a chronic blepharoconjunctivitis. A large gram-negative diplobacillus which does not grow on plain medium, but which actively liquefies Loeffler's blood serum, may be considered to be this organism.

SPECIAL CONSIDERATIONS

Lacrimal Conjunctivitis.—This type of conjunctivitis is secondary to infection of the lacrimal sac and does not respond to treatment of the conjunctiva. The prognosis is most favorable in the new-born, in whom the lacrimal stenosis usually heals spontaneously. In the adult the

3. Kleuver, H. C.: Chronic Streptococcic Pseudo-Membranous Conjunctivitis, to be published.

condition usually requires either removal of the sac or one of the more physiologic operations which restore drainage into the nose. The chronic conjunctivitis which follows dacryocystectomy is usually nonbacterial and probably results from the disturbance in lacrimal function.

The commonest agents in lacrimal conjunctivitis are, in order of frequency: D. pneumoniae, H. influenzae and Str. haemolyticus.

Vernal Catarrh.—Although the etiology of this disease has not yet been established, the constant finding of eosinophilic cells in the conjunctival secretion is of diagnostic importance. The eosinophils are typically fragmented, and the eosinophilic granules widely scattered. The finding of scattered eosinophilic granules, even though few cells are present, is extremely suggestive of vernal catarrh and is particularly useful in doubtful cases in which the clinical signs of the disease are not fully developed. A number of subclinical cases which present the subjective but not the objective signs of the disease, yield positive microscopic evidence. Scrapings from the upper tarsal conjunctiva are the most instructive.

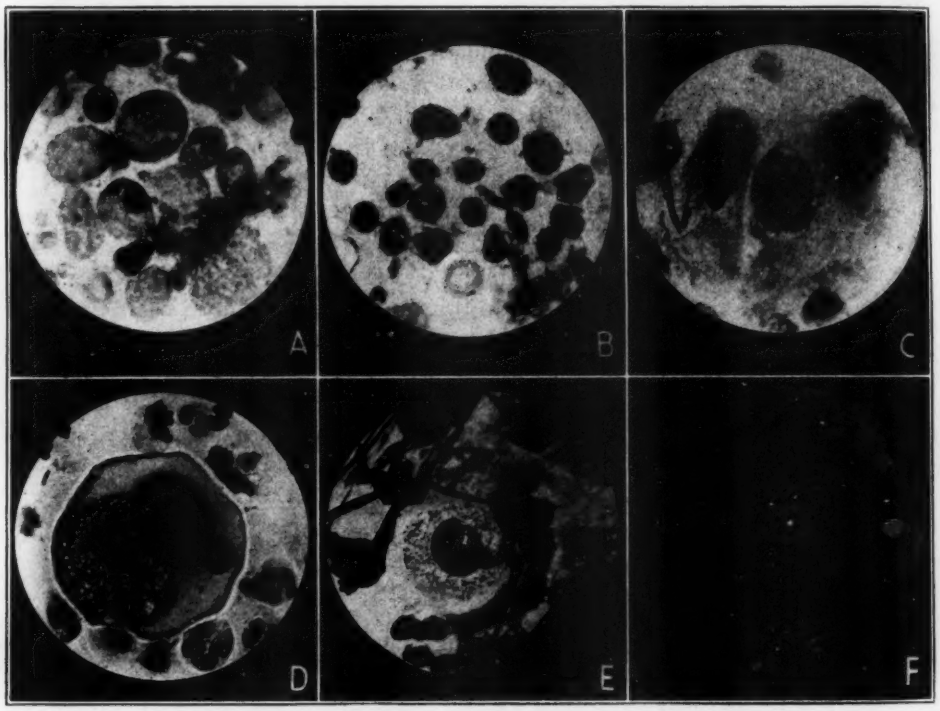
Inclusion Conjunctivitis.—I am of the opinion[4] that the term "inclusion conjunctivitis" should include the two nonbacterial conjunctival diseases, inclusion blennorrhea and swimming pool conjunctivitis, which are caused by a single virus. The name "swimming pool conjunctivitis" should be discarded in favor of "adult inclusion conjunctivitis" since the swimming pool no longer plays a major part in the spread of the disease. The majority of cases now seen are the result of direct transfer from inclusion disease of the genito-urinary tract.

Inclusion Conjunctivitis of the New-Born (Inclusion Blennorrhea).—Inclusion bodies are plentiful in epithelial scrapings made during the first few weeks of the disease. Diagnosis may be made from them or from the finding of free elementary and initial bodies in secretion smears.

Adult Inclusion Conjunctivitis (Swimming Pool Conjunctivitis).—This disease usually appears as a follicular conjunctivitis, subacute at the onset. Occasionally, however, it is seen as a papillary conjunctivitis in which follicles are either absent or masked by the papillary hypertrophy. The latter type is the more severe. Inclusion bodies are often abundant in the early stages although never in such numbers as in the disease of the new-born. In the former type the inclusions are few and are commonly found only during the first few weeks of the disease. Free elementary and initial bodies are sometimes present even when inclusion bodies are not demonstrable.

4. Thygeson, P.: Etiology of Inclusion Blennorrhea, Tr. A. Research in Ophth., 1934, to be published.

It is this type of follicular conjunctivitis which is most often confused with trachoma. The examination of expressed follicular contents after Giemsa staining is a useful diagnostic procedure. In trachoma the large mononuclear cells (fig. 1 *A*) predominate, while in all forms of follicular conjunctivitis the small mononuclear cells are the most numerous (fig. 1 *B*). In the trachoma follicle the central portion, made up of large mononuclear cells, has undergone gelatinous degeneration and may be expressed easily. The follicles in follicular conjunctivitis,



A shows expressed follicular material from a case of trachoma; large mononuclear cells predominate. *B* shows expressed follicular material from a case of follicular conjunctivitis; small mononuclear cells predominate. *C* shows early (initial body) inclusions from a case of inclusion blennorrhea. *D* shows intermediate (mixed initial and elementary body) inclusions, two in a single cell. The inclusion on the right is the less mature. *E* shows a late (elementary body) inclusion. The cytoplasm of the epithelial cell has been entirely replaced by elementary virus granules. *F* shows elementary bodies in a preparation of secretion from a case of subacute trachoma without secondary infection.

on the other hand, are hard and have to be torn out in toto. The small mononuclear cells making up the peripheral portions of the follicles then appear in greatest number.

Trachoma.—Actively secreting, so-called acute trachoma [5] may be divided into three types, as follows:

1. Chronic trachoma plus superimposed infection. Contaminating bacteria are found in smears and cultures. Inclusions and free bodies are rare.

2. Subacute trachoma plus superimposed infection. Secondary bacterial agents are found in smears and cultures. Inclusions and free bodies are often numerous.

3. Subacute trachoma, unassociated with pathogenic bacteria. Inclusions and free bodies are numerous.

In chronic trachoma the inclusion bodies and free bodies are found with such difficulty that search for them is not recommended. The fact that large mononuclear cells predominate in expressed follicular materials aids in the differential diagnosis from follicular conjunctivitis, in which the lymphocytes predominate.

Inclusion Bodies.—The cytoplasmic inclusion bodies of trachoma and inclusion conjunctivitis are basophilic and heterogeneous, differing from the inclusions of most other virus diseases, which are acidophilic and homogeneous. That this difference is more apparent than real is suggested by the findings of Goodpasture and Woodruff [6] and of Goodpasture, Woodruff and Buddingh,[7] which indicate that such typical virus inclusions as those of vaccinia and fowlpox are composed of masses of elementary virus particles embedded in acidophilic matrices. The elementary bodies of these two diseases, as well as those of psittacosis,[8] closely resemble in size and staining reaction the elementary bodies of trachoma and inclusion conjunctivitis. The discovery that the virus of psittacosis has a life cycle resembling that of the virus of inclusion conjunctivitis further emphasizes the essential similarity of the cytoplasmic virus inclusions.

The inclusions of trachoma and inclusion conjunctivitis have in the past been confused with nonspecific bodies, such as extruded nuclei,[9] phagocytosed nuclear fragments and phagocytosed bacteria.[10] Such

5. Thygeson, P.: The Nature of the Elementary and Initial Body of Trachoma, Arch. Ophth. **12**:307 (Sept.) 1934.

6. Goodpasture, E. W., and Woodruff, C. E.: A Comparison of the Inclusion Bodies of Fowl-Pox and Molluscum Contagiosum, Am. J. Path. **7**:1 (Jan.) 1931.

7. Goodpasture, E. W.: Woodruff, A. M., and Buddingh, G. J.: Am. J. Path. **8**:271 (May) 1932.

8. Bedson, S. P., and Bland, J. O. W.: A Morphological Study of Psittacosis Virus, Brit. J. Exper. Path. **13**:461 (Oct.) 1932.

9. Gifford, S. R., and Lazar, N. K.: Inclusion Bodies in Artificially Induced Conjunctivitis, Arch. Ophth. **4**:468 (Oct.) 1930.

10. Williams, A.: A Study of Trachoma and Allied Conditions in the Public School Children of New York City, J. Infect. Dis. **14**:261 (March) 1914.

confusion is unnecessary if one has had an opportunity to study early cases of inclusion blennorrhea in which the various stages in the development of the inclusions from the initial body form to the elementary body form[4] are easily found. For convenience of reference the inclusions may be spoken of as early (initial body), seen in figure 1 *C*, intermediate (mixed), seen in figure 1 *D*, and late (elementary body), seen in figure 1 *E*.

Free elementary and initial bodies are frequently useful in diagnosis, particularly in acute trachoma and in inclusion blennorrhea, in which they often appear in large numbers (fig. 1 *F*). The initial bodies stain blue and bipolarly with Giemsa's stain and are coccobacillary in shape. The elementary bodies are small granules about 0.25 micron in diameter, which stain reddish blue with Giemsa's stain. They may be identified from their uniform size and frequently diplococcic form, and from the fact that they are alcohol-fast, while nonspecific granules, such as neutrophilic granules, decolorize readily.

Results Obtainable with Combined Film and Culture Technic.—Some indication of the results to be expected from the technic described in this report is given by the following figures derived from the study of 314 consecutive cases of conjunctivitis at the ophthalmologic clinic of the University Hospital, Iowa City:

	Percentage of Cases in Which Etiologic Agent Was Determined
Acute conjunctivitis	91
Subacute conjunctivitis	85
Chronic conjunctivitis	46

THERAPEUTIC CONSIDERATIONS DERIVABLE FROM BACTERIOLOGIC EXAMINATION

Acute Conjunctivitis.—Immediate bacteriologic diagnosis is indicated in all cases of acute conjunctivitis, since gonorrheal ophthalmia in its early stages often cannot be distinguished clinically from the benign types of conjunctivitis. An early diagnosis with the institution of proper therapy, such as the use of foreign protein and of 0.5 per cent silver nitrate ointment, can mean the conservation of an eye which under ordinary circumstances would be lost. It is of importance to determine the presence of the pneumococcus, since an effective chemotherapeutic agent, 1 per cent optochin, is available. In conjunctivitis caused by the Koch-Weeks or by the influenza bacillus the importance of determining the etiology is less obvious, since the treatment of these infections is nonspecific. The use of silver nitrate ointment (0.5 per cent) four times daily is effective and much more satisfactory than the application of the solution to the palpebral conjunctiva. The ointment reaches the bulbar conjunctiva, which is heavily infected while the solution affects only the parts to which it is applied.

Pseudomembranous Conjunctivitis.—Bacteriologic examination is of the greatest importance in chronic pseudomembranous conjunctivitis, since an effective antitoxin is available for use in diphtheritic infection. The antitoxin should be used locally and parenterally. In conjunctivitis caused by hemolytic streptococci the favorable action of scarlet fever antitoxin has recently been demonstrated.[3] The use of this method of therapy is certainly indicated in a disease which so often causes loss of the globe and which is resistant to the usual methods of treatment.

Chronic Conjunctivitis.—There is probably no ophthalmologist who has not encountered cases of chronic conjunctivitis which have presented puzzling therapeutic problems. Laboratory examination is of definite aid in the management of certain of these difficult cases. Four groups of cases are encountered: (1) those caused by the diplobacillus of Morax, (2) those caused by Staphylococcus pyogenes-aureus, (3) those in which eosinophilic cells are found in the conjunctival secretion and (4) those with negative findings. In the first group the condition responds satisfactorily to treatment with zinc sulphate. Here, again, the ointment is more satisfactory than the solution. Particular attention should be paid to the lid margins, and treatment should be continued for at least a month after cessation of symptoms in order to prevent recurrence. In the second group treatment is more difficult, since no specific chemotherapeutic agent is known. The staphylococci often localize at the lid margins and in the orifices of the glands and thus escape medication. Silver nitrate ointment is useful and may be applied directly to the lid margins. Vaccines are often valuable.[11] In the third group the presence of eosinophils is indicative either of early or of subclinical vernal catarrh or of simple conjunctival allergy. The fourth group is unfortunately a large one in which no laboratory aid is forthcoming. In all cases of this group careful slit-lamp examination of the cornea should be made, since a superficial punctate keratitis will be found in a certain number. While no effective therapeutic agent is available for superficial punctate keratitis, the finding is useful for prognostic purposes.

In cases of trachoma with acute or subacute symptoms it is of therapeutic importance to determine whether the inflammatory signs are due to superimposed bacterial infection or to action of the trachoma "virus" [5] itself. Silver nitrate is indicated in the first instance and copper sulphate in the second. In the inclusion virus infections (inclusion blennorrhea and swimming pool conjunctivitis), determination of the etiology is important since the treatments effective against bacterial diseases of the conjunctiva are in these conditions entirely

11. Woods, A. C.: Allergy and Immunity in Ophthalmology, Baltimore, Johns Hopkins Press, 1933, p. 163.

ineffective. The use of irritating concentrations of silver nitrate subjects the patient to additional discomfort and in no way shortens the course of his illness.

The follicular type of swimming pool conjunctivitis is found in only a small, though an important, proportion of the total cases of follicular conjunctivitis. A certain number of these cases are toxic, such as those due to physostigmine and atropine, some are follicular reactions to bacterial toxins and some are infections of unknown etiology. It is well known that the diplobacillus of Morax often produces follicular conjunctivitis in children, and similarly a chronic infection with Staph. pyogenes-aureus has been known to induce follicle formation in susceptible persons. The recognition of the etiology, when possible, is obviously necessary for the proper management of follicular conjunctivitis.

An occasional case of conjunctival folliculosis is seen in which the child complains of secretion, photophobia and irritation. Cultures in these cases usually reveal evidence of secondary infection, and appropriate therapy results in relief from symptoms. The follicular hypertrophy in these cases remains unchanged. Another type of case is seen, however, in which the conjunctiva of the lower lid presents a granular appearance and there is often an associated blepharitis. This simulates folliculosis but is actually a papillary hypertrophy resulting from low grade bacterial infection. Response to zinc therapy is usually good since the diplobacillus of Morax is the commonest cause.

TEACHING OF OPHTHALMIC BACTERIOLOGY

Instruction in ophthalmic bacteriology should be a part of every graduate course in ophthalmology, and it is desirable that every ophthalmic intern have practical experience in the subject. Eventually it might well be included among the subjects covered in the examination of the American Board for Ophthalmic Examinations.

It has been possible to prepare a set of microscopic preparations from the bacterial and virus diseases of the conjunctiva, so stained and mounted as to resist fading. Such a set is a valuable aid in the instruction of interns and as a reference source. Duplicate sets are being prepared and will be lent to members of the medical profession who are interested.

SUMMARY AND CONCLUSIONS

The determination of the etiology of conjunctival infections is of importance for diagnostic, prognostic and therapeutic reasons. A simplified technic, illustrated with charts and diagrams, applicable to the routine bacteriologic diagnosis of the majority of the common con-

junctival inflammations, is described. The therapeutic indications derivable from such studies are discussed.

A study set of illustrative microscopic slides of the conjunctival bacteria is presented. It is suggested that similar sets be made available to members of the medical profession for teaching and for reference purposes.

ABSTRACT OF DISCUSSION

DR. FREDERICK H. VERHOEFF, Boston: The essayist has described the methods that he has found the most satisfactory for identifying the micro-organisms that are present in the conjunctival secretion in certain forms of conjunctivitis, and also the methods that he has used to demonstrate inclusion bodies. He has described the important characteristics of the micro-organisms considered and has called attention to some methods of treatment that he has found especially advantageous. The extensive experience of the essayist in the field of ophthalmic bacteriology makes his contribution of great interest and value. I feel sure that few, if any, of his statements can be controverted.

The title that he has selected, however, lays him open to criticism—one less comprehensive would have disarmed me—for it indicates that his communication deals with all forms of conjunctivitis and with all the factors concerned in their causation, whereas, in fact, it deals with only some of the common forms of conjunctivitis and, as regards etiology, only with microbic agents.

Thus, among other conjunctival conditions, he omits all reference to tuberculous, phlyctenular, Parinaud's and herpetic conjunctivitis, squirrel plague, ophthalmia nodosa, conjunctivitis due to insect bites, pemphigus of the conjunctiva and rosacea conjunctivitis.

In my experience, the last-mentioned disease is the most common form of chronic conjunctivitis, and the form that is most often unrecognized. The essayist does not mention the phytopharmacologic test of Macht for the diagnosis of trachoma. It is believed that this, as carried out by means of pine tree rootlets, is specific for trachoma with the exception that it does not distinguish it from pemphigus.

He does not bring out that swimming pool conjunctivitis may be acquired from other sources than swimming pools and that enlargement of the preauricular glands is of some importance in the diagnosis of this condition.

In connection with lacrimal conjunctivitis, streptothrix concretions in the canaliculi are not referred to. I have observed many cases of unilateral conjunctivitis which had been investigated bacteriologically and in which various types of treatment had been used for a year or more without beneficial results but in which removal of an unsuspected streptothrix concretion from a canaliculus has accomplished a complete cure within about one week.

The essayist does not mention that diphtheritic conjunctivitis may be due to Corynebacterium ulcerans and that diphtheria antitoxin is useless in infections due to this bacillus. Apparently the essayist has been no more successful than others in definitely distinguishing trachoma from other forms of inclusion conjunctivitis by the examination of conjunctival secretion or scrapings.

The essayist advocates the use of an ointment of silver nitrate in various forms of conjunctivitis, and of optochin in pneumococcic conjunctivitis. I have had no experience with the use of optochin. My results in the treatment of pneumococcic conjunctivitis with the well known solution of boric acid and zinc sulphate have been so prompt and satisfactory that it is difficult for me to believe that optochin could yield better results.

The essayist's suggestion that scarlet fever antitoxin should be used in cases of conjunctival infections with hemolytic streptococci seems to be of great value. With the essayist's views regarding instruction in ophthalmic bacteriology, I am sure no one will disagree.

Dr. Edward Jackson, Denver: Such a way of thinking of conjunctivitis as Dr. Thygeson illustrated in his presentation of the subject is practical; it is within the reach of all ophthalmologists.

There must be large regions in this country, as in the state of Colorado, where acute contagious conjunctivitis is unknown. Dr. Gifford rarely encountered it in Omaha. In more than thirty years in Denver I have found the Koch-Weeks bacillus in only three cases; and those three cases were clearly contracted in other parts of the country, at low altitudes.

Most of the members of this section would look for and recognize the gonococcus morphologically, yet, clinically, cases in which it is found may not prove to be instances of gonococcic conjunctivitis. I remember a case in which bacteriologists reinforced my opinion that the appearance of the smears justified the diagnosis of gonococcic conjunctivitis. But the complete disappearance of symptoms and of the organisms within three days convinced us that the causative agent was not the gonococcus.

An etiologic agent which is often overlooked, but which can be recognized by the microscopic methods, is the Morax-Axenfeld diplobacillus. The most common organism that might cause confusion is the pneumococcus. But even the shape of a single diplococcus, or diplobacillus, at first glance will suggest the rod shape of the bacillus, as distinguished from the olive shape of the pneumococcus.

In conjunctivitis due to this organism microscopic examination of the smears is important. It is a very widely distributed form of conjunctivitis and can last for weeks and months, without its cause being recognized.

A case of that kind occurred in a wool buyer. His history made it pretty certain that he felt the trouble when he was in Australia. He had been to San Francisco, to Omaha, and to two other places, where he had careful examination by ophthalmologists. With active treatment with zinc sulphate he was getting well in two days.

Dr. Phillips Thygeson, Iowa City: I believe that Dr. Verhoeff is justified in his criticism of the title. The distribution of the Koch-Weeks bacillus conjunctivitis is extremely interesting and is an important point in the differentiation between it and the influenza bacillus, which many bacteriologists believe are identical. The cultural characteristics of the two organisms are the same. Morphologically, however, a difference is apparent in the secretion smears, though the morphologic characteristics appear identical in culture.

The recognition of the gonococcus seems to me to be accurate if one uses epithelial scrapings, because although one occasionally sees other gram-negative cocci, I have not seen a report of the findings of these cocci on epithelial cells. They multiply in the secretions, but not on or in the epithelium.

SARCOMA OF EYELID

METAPLASIA OF LEIOMYOSARCOMA TO ROUND CELL SARCOMA AFTER REPEATED ATTEMPTED EXCISIONS

T. L. TERRY, M.D.
BOSTON

In 1927, Stanowsky [1] collected sixty-five cases from the literature of sarcoma of the eyelid and reported two more cases. Additional cases were reported by Juler,[2] Stock,[3] Rifaat (three cases),[4] Fiore,[5] Nichelatti,[6] Gabriélidès,[7] Jaensch (three cases),[8] DeLogu,[9] Ishibashi [10] and Vele (three cases).[11] The ages of the patients varied from a few months to 80 years. The distribution according to sex was approximately equal. In the preponderance of cases the upper eyelid was involved. Many of the tumors when first seen were mistaken for chalazions, and their true nature was recognized later. The type of cell varied, round, spindle and mixed types being reported. Some of the tumors contained melanotic pigment. Some were excised without recurrence, and a few disappeared after irradiation. Some showed local recurrence; some showed metastases, and several showed extension to regional lymph nodes. Many extended beyond the tarsal plate, and some extended into the

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From the Massachusetts Eye and Ear Infirmary and Harvard University Medical School.

1. Stanowsky, Paulina: Primares Lidsarkom, Arch. de oftal. de Buenos Aires **2**:404, 1927.

2. Juler, Frank: Diseases of the Eyelids: Sarcoma of the Eyelid, with Local Secondary Growth Apparently Cured by Radium, Tr. Ophth. Soc. U. Kingdom **47**:81, 1927.

3. Stock, W.: Tumoren, Klin. Monatsbl. f. Augenh. **81**:111, 1928.

4. Rifaat, A.: Trois cas de sarcome primitif des paupières, Ann. d'ocul. **165**: 508, 1928.

5. Fiore, Tito: Sarcoma endoteliale della palpebra superiore (tarso), Ann. di ottal. e clin. ocul. **58**:54, 1930.

6. Nichelatti, Paolo: Contributo clinico ed istologico allo studio di alcuni tumori palpebrali non comuni, Boll. d'ocul. **10**:882, 1931.

7. Gabriélidès, C.: Sarcome primitif apigmenté de la paupière, Ann. d'ocul. **169**:593, 1932.

8. Jaensch, P. A.: Bösartige Geschwülste unter dem Bilde von Hagelkörnern; Epitheliome und Sarkome der Lider, Klin. Monatsbl. f. Augenh. **90**:598, 1933.

9. DeLogu, Antonio: Sarcoma palpebrale primitivo a struttura linfo-endoteliale piu volte recidivato, Boll. d'ocul. **12**:313, 1933.

10. Ishibashi, Shun: Ein seltener Fall vom primären "Sarcoma perivasculare" des Lides, Acta Soc. ophth. jap. **37**:361, 1933.

11. Vele, Maria: Sui tumori delle palpebre, Boll. d'ocul. **12**:788, 1933.

orbit, necessitating extensive operation. A statistical tabulation of the data is impossible, since many of the cases were not reported in sufficient detail.

REPORT OF A CASE

A woman, 51 years of age, came to the Massachusetts Eye and Ear Infirmary because of a nodule on the upper lid of the right eye, which was first noticed about three months previously.

She gave a history of having the nodule punctured two months previously by a local physician. On examination there was found a small polypoid projection of rather hyperemic tissue from the upper lid at the juncture of its outer and middle third, at the margin of the tarsal plate. This appeared typical of a granulating mass following rupture or incision of a chalazion, but it was attached across the retrotarsal fold to the orbital tissue in the region of the lacrimal gland. Biopsy was performed, and the tissue proved to be a leiomyosarcoma. The diagnosis was confirmed by Dr. F. H. Verhoeff, Dr. Tracy Mallory and the late Dr. James H. Wright. It was then discovered that the patient had had fibroids of the uterus, on account of which that organ had been removed about five years previously. Unfortunately, no microscopic study had been made of the fibroids. Examination in the Massachusetts General Hospital revealed no evidence of a pelvic tumor.

The patient would not consent to have exenteration of the orbit performed. The surgeon limited himself to local removal of the tumor. The operation was necessarily extensive and resulted in symblepharon and limitation of motility of the globe.

The patient was carefully followed, and five months later a recurrence of the tumor was noted. It was removed, along with much of the lacrimal gland. A second recurrence was noted within one month, and exenteration of the orbit was performed.

About four months after the exenteration there was a recurrence of the tumor. The orbital roof was involved. The growth was again removed, and 20 mg. of radium was inserted for one hundred and twenty-two hours.

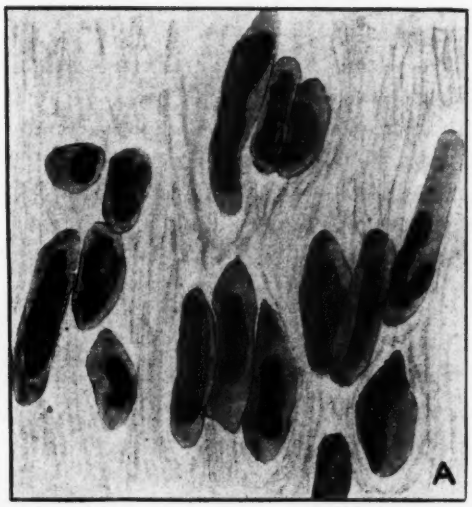
One month later, pain developed in the lower portion of the back. A roentgenogram showed a mottled shadow in the eleventh dorsal vertebra. This was considered to be a metastasis. Thorough clinical and roentgen studies failed to reveal other metastases.

Two months later, the patient died at her home. Necropsy was not possible, and the cause of death was not known, although it was considered by her local physician to be due to the tumor.

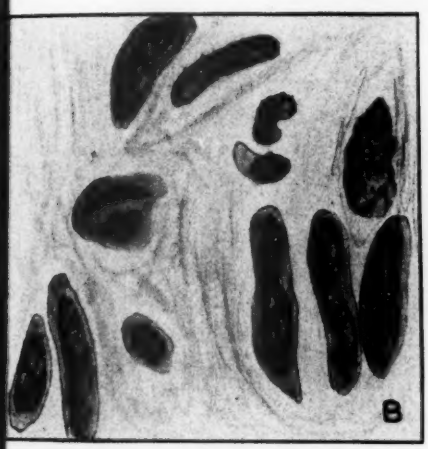
The illustrations show the cellular characteristics of the five successive specimens of the tumor. There is a progressive transition from typical leiomyosarcoma cells with rod-shaped nuclei to cells which are practically all round. There are nuclear changes present in the successive specimens, which suggest an increase in the malignancy. Mitotic figures were rare in the first specimen, but numerous in the last specimen.

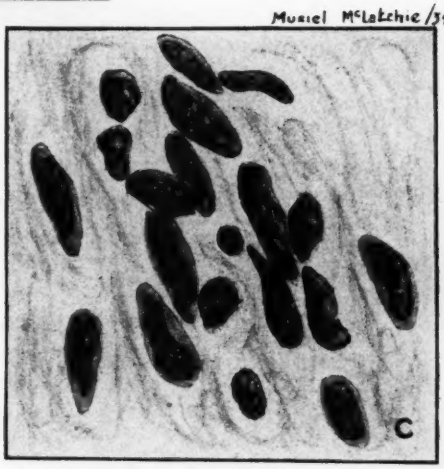
COMMENT

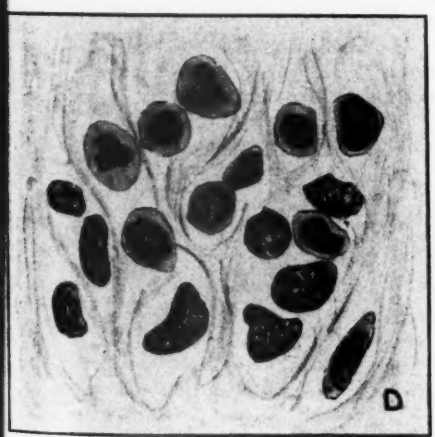
The question of leiomyosarcoma arising from Müller's muscle has never been discussed in the literature. This case is highly suggestive of such an origin, but there is the possibility of a very late metastasis from the tumor of the uterus. It is my impression that this tumor had its origin from Müller's muscle.

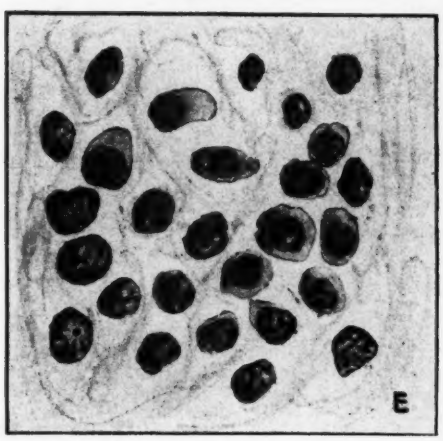


Muriel McLatchie /34









Camera lucida drawings of typical groups of cells from the tumor at (*A*) biopsy, (*B*) first operation, (*C*) second operation, (*D*) third operation and (*E*) fourth operation.

It has long been known that tumors change their characteristics as a result of operative trauma.

Several general pathologists with whom this matter was discussed have never observed a leiomyoma of the uterus or, in fact, of any organ to change its characteristics as the tumor in this case did. This strongly suggests not only that the present tumor arose from Müller's muscle but also that some of the tumors of the eyelids described as sarcomas were really leiomyosarcomas.

CONCLUSIONS

1. Leiomyosarcoma may arise from Müller's muscle of the lids.

2. Leiomyosarcoma can, after repeated operative trauma, become metamorphosed into a tumor that cannot be distinguished from a round cell sarcoma.

3. Sarcoma of the eyelid requires radical treatment.

EPENDYMOMA OF THIRD VENTRICLE

REPORT OF A CASE WITH EXTENSION INTO THE OPTIC CHIASM AND WITH WIDESPREAD VEGETATIVE MANIFESTATIONS

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AND
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Involvement of the optic chiasm from its inferior surface occurs with fair frequency owing to the high incidence of pituitary neoplasms. Involvement of the optic chiasm from its superior surface, that is, from impingement on it by lesions proceeding from the floor of the third ventricle, occurs less frequently, while actual invasion of the chiasm is extremely rare. The present report presents a case of a neoplasm extending into the substance of the optic chiasm.

Recently there was reported a case of an extensive glioma of the third ventricle,[1] serial sections of which showed that the sheath of the optic nerve and optic chiasm had resisted the invasion of the tumor cells. The fact that there was only a slight invasion of the inferior border of the right optic tract indicates the marked resistance of these structures to the infiltration.

Wilbrand and Saenger[2] pointed out that direct invasion of the chiasm by a tumor is extremely rare. Kon[3] described three cases of tumor in the region of the hypophysis; one of these growths, a teratoma with derivatives of all three germinal layers, invaded the chiasm and the third ventricle. Paukstat[4] reported a case in which a glioma sprang from the anterior surface of the chiasm, surrounded the optic nerves and produced bitemporal hemianopsia.

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Dr. Clarence King, professor of ophthalmology, assisted in the preparation of this report.

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3. Kon, J.: Seltene Tumoren der Hypophysengegend (Teratom, Peritheliom, telangiektatisches Sarkom), Beitr. z. path. Anat. u. z. allg. Path. **44**:223, 1908.

4. Paukstat: Beitrag zur Lehre von der bitemporalen Hemianopsie, Klin. Monatsbl. f. Augenh. **43**:605, 1905.

REPORT OF CASE

History.—W. P., a man, aged 40, was admitted to the Cincinnati General Hospital on March 6, 1930, for treatment of headaches and visual disturbances. He stated that about one year previously he began to have frontal headaches, with pain radiating to the back of the head. These headaches were moderately severe, and at first were infrequent, but for the past two months had been present almost constantly. He noticed an impairment of the vision of his left eye about one year prior to entering the hospital, but in the week preceding admittance the dimness became much worse, so that he had the impression that he was looking through a cone when using the left eye alone. Also, in the last few weeks he had

Fig. 1.—The brain has been sectioned horizontally. There has also been a frontal section, but the two halves of the brain have been placed together. The tumor is seen filling the entire cavity of the third ventricle.

noticed a dimness of vision in the right eye. Both eyes were painful, although most of the visual and painful disturbance had been experienced in the left eye.

Some nocturia had been experienced, and he had some difficulty in retaining urine. During the last two weeks he had noticed that there was a tendency to stagger as if he were drunk. For the past six months the patient had complained of impotency. He had a slight diminution in memory, and his wife told him that he acted queerly. He had dizzy spells occasionally and buzzing and ringing of the ears.

A supplementary history obtained from the patient's wife after his death revealed that for several months prior to entrance to the hospital he had been drinking much more water than usual, with subsequent nocturia and polyuria. She

also noted that his skin changed to a darker color, especially around the eyes (the patient was of mixed blood, colored and white, but had had a white skin previous to this time). There was a gradual loss of memory, especially for recent events, as well as irritability and a tendency to neglect his personal appearance. There was also an increasing tendency to lethargy and drowsiness; on one occasion he fell asleep on a curb leaning against a pole. During the year prior to entrance to the hospital his hair grew gray rapidly, and he subsequently became bald.

Physical Examination.—The patient was well developed and fairly well nourished and did not appear acutely ill. Examination of the heart, lungs and abdomen revealed no abnormalities.

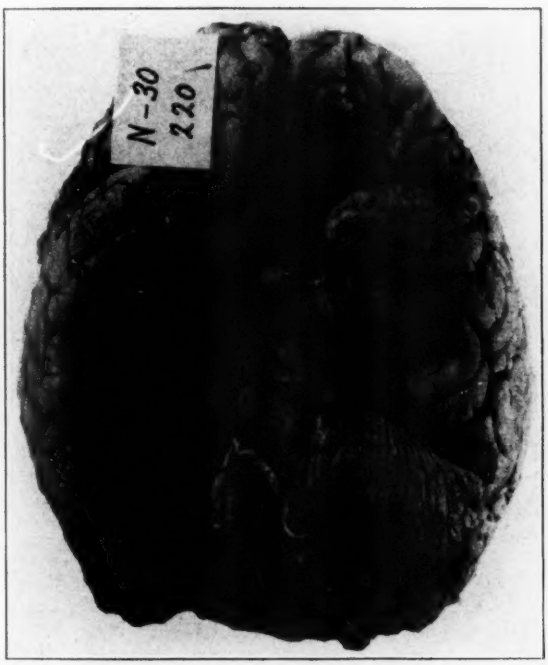

Fig. 2.—The tumor, obliterating the entire tuber cinereum, is shown just posterior to the optic chiasm. The right optic nerve is thrust forward as a result of the growth.

The conjunctivae were clear. The pupils were equal and moderately dilated and reacted fairly well to light and in accommodation. The perimetric reading for form was as follows: right eye, contraction of temporal visual field to 60 degrees; left eye, concentric contraction of visual field to 40 and 50 degrees. The visual acuity was not tested. The ocular muscles presented no paralysis or paresis, and no diplopia was elicited. Examination of the fundi revealed bilateral choked disk.

There was definite impairment of hearing in the left ear, but the olfactory and gustatory functions were not impaired, and the other cranial nerves gave normal responses. The deep reflexes were present, but the abdominal reflexes were absent on both sides. There were no pathologic reflexes. In Romberg's position there

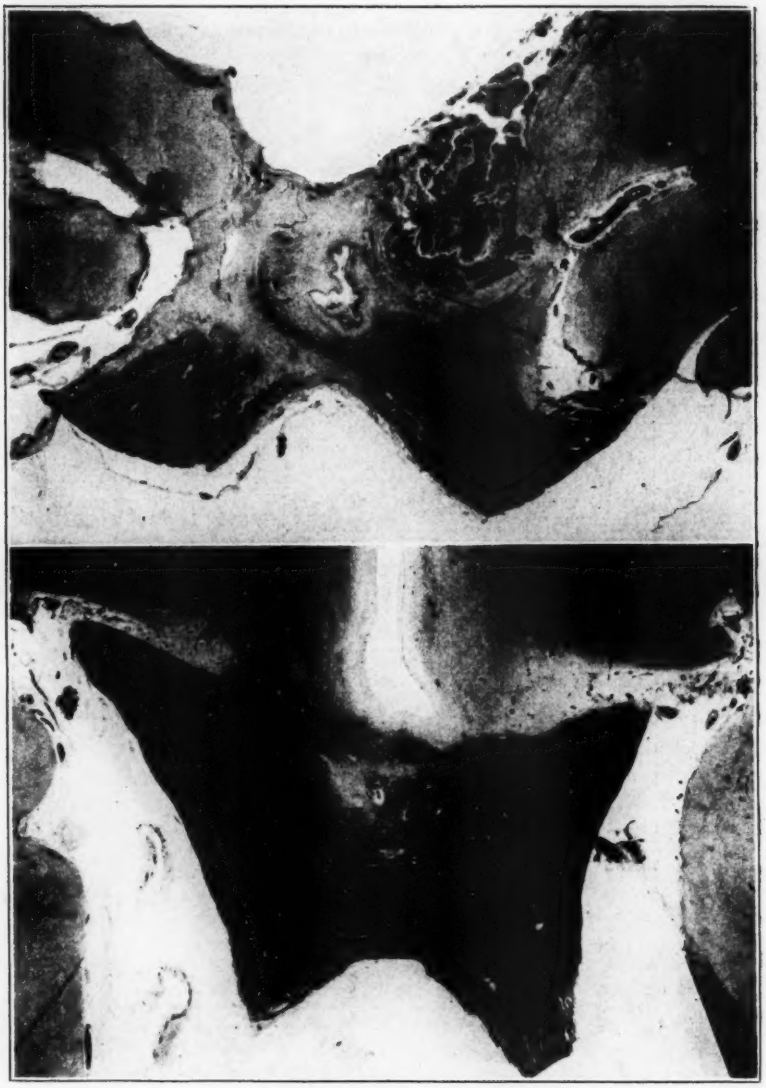

Fig. 3.—The lower photomicrograph shows an approximately normal optic chiasm. It is introduced for comparison with the specimen above, which shows the neoplasm extending into the optic chiasm from the floor of the third ventricle. Note the enormous distention of the third ventricle and the marked loss of myelin in the adjacent portions of the brain, as revealed by absence of staining qualities (Morgan's stain).

was a tendency to fall to the right. No sensory disturbances were detected. The cerebrospinal fluid was under a pressure of 31 cm. and yellow. Urinalysis revealed no abnormalities. Examination of the blood showed 80 per cent hemoglobin and 10,000 white cells per cubic millimeter.

A roentgenogram of the head showed the sella turcica to be very shallow but without evidence of erosion of any of its processes. The antrum and the right ethmoid area were slightly cloudy, suggesting low grade infection. Encephalograms made following an injection of air into the lumbar area showed the lateral ventricles to be completely outlined but quite large and suggestive of internal hydrocephalus. The third ventricle did not fill, and no evidence of air was seen in the convolutions of the brain.

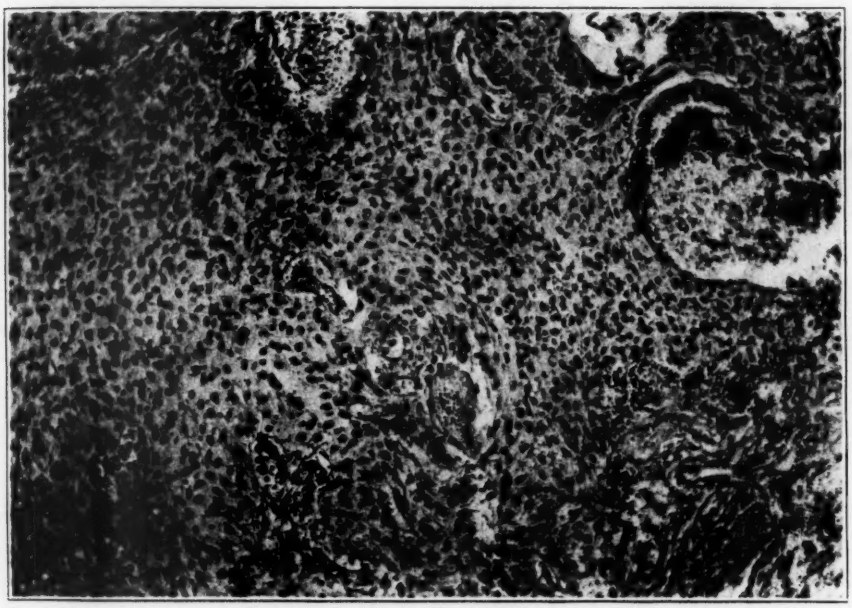

Fig. 4.—The section is taken from the tumor. The characteristic cells are large, with granular nuclei and granular cytoplasm. There are many vascular channels. In some instances the tumor cells are grouped around the blood vessels.

Course in the Hospital.—A subtentorial craniotomy was performed four days after the patient's entrance to the hospital. No tumor was located in the cerebellum. Fifteen days after his admission another exploratory craniotomy was done. A bone flap in the left frontotemporal area was turned back. The frontal lobe was elevated and the region of the hypophysis explored. No tumor was found. Death occurred on April 9, thirty-four days after the patient's admission.

Postmortem Examination.—Postmortem examination was permitted only on the head. The brain was edematous and flattened. On horizontal section, both ventricles were dilated and filled with cerebrospinal fluid. There was a bulging mass in the third ventricle.

The brain was reexamined after fixation in a dilute solution of formaldehyde, U.S.P. The tuber cinereum was markedly dilated, and the infundibulum was enlarged. The optic chiasm was thrust forward. The blood vessels over the

cortex were congested. The convolutions were flattened and the fissures narrowed. Horizontal section of the brain revealed a firm mass filling the entire cavity of the third ventricle. The lateral ventricles were dilated. The tumor extended posteriorly far enough to occlude the entrance of the aqueduct of Sylvius. The pineal body was intact. On section through the tumor there was found a recent blood clot which contrasted markedly with the yellow to gray appearance of the tumor tissue. The larger part of the growth was removed from the third ventricle. The left wall of the ventricle, after removal of the mass, was seen to be distended much more than the right. A portion of the tumor was strongly adherent to the floor of the third ventricle at the tuber cinereum. The growth appeared to spring from the ependyma of the floor of the third ventricle at the site of junction with the optic chiasm. There was also a point of attachment on the left lateral wall of the ventricle. The extrusion of the tuber cinereum destroyed the mamillary bodies.

The diagnosis was: a tumor obliterating the cavity of the third ventricle, with hemorrhage into the mass; cerebral edema and congestion, and internal hydrocephalus of both lateral ventricles secondary to obstruction of the aqueduct of Sylvius.

Sections were taken through the tumor, stained with hematoxylin and eosin and examined microscopically. At the ependymal border of the mass were many layers of large cells with large granular nuclei and granular cytoplasm. Extending away from this border the relative amount of cytoplasm of the cells was increased, and the mass was thickly set with vascular channels. In some instances the tumor cells grouped themselves in whorls around blood vessels. In some areas there could be seen a deposit of fibrin and apparently some fibrous organization. These areas were heavily infiltrated with red blood cells and were apparently the sites of recent hemorrhage.

A block of brain tissue which included the entire third ventricle, the optic chiasm and tract and the anterior portion of the pons was embedded in pyroxylin. Serial sections were made through the entire area and stained with iron hematoxylin according to the method of Morgan.[5]

Study of these sections revealed widespread pathologic change. The fiber pathways in the corpus callosum immediately superior to the third ventricle presented marked degenerative changes, evidently an effect of pressure. The columns of the fornix in the roof of the third ventricle were similarly affected. There was marked cell loss in the thalamus. The fiber tracts of the internal capsule on each side showed loss of myelin. The anterior commissure was invaded by the tumor. The globus pallidus showed a loss of cells. The optic chiasm was directly invaded by the tumor. The tuber cinereum was completely replaced by neoplastic growth.

SUMMARY AND COMMENT

A case of direct invasion of the optic chiasm by ependymoma is presented. There were various vegetative manifestations: increased intake and output of fluids, sexual impotence, increased pigmentation of the skin, lethargy and premature graying of the hair followed by baldness. An explanation of these findings is found in an involvement either by pressure or by invasion of the vegetative area of the brain implicating chiefly the tuber cinereum and the floor and walls of the third ventricle.

5. Morgan, L. O.: Anat. Rec. **32**:283 (April) 1926.

WHEN AND HOW SHOULD ONE OPERATE FOR CONVERGENT STRABISMUS?

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The question "When and how should one operate for convergent strabismus?" was asked at a recent meeting, and I made the statement at the time that a question involving so many considerations could not be answered in the time allowed. One hears much discussion on the subject of whether some form of advancement or some form of recession is the better procedure for the correction of convergent strabismus. This discussion seems futile, for when an external rectus needs help, no form of tenotomy on an internal rectus will be of much aid, and when an internal rectus is too powerful, no form of advancement will give the desired results. If one confines the discussion to the means of aiding the external rectus one may consider the advantage and disadvantage of an advancement or any of its modifications, of a resection or its modifications, of a tucking and its modifications or of the cinch operation or any other procedure to accomplish this purpose. I believe that it makes little difference which operation on the external rectus is chosen, so long as the operator perfects his technic. When new technics are brought out the objections to the former technic are chiefly attributable to the mistakes of the operator who is objecting to them.

Any one viewing many postoperative cases has seen beautiful results from any of the aforementioned procedures for aiding the external rectus, and in some cases total failures with the same technic carried on equally well. The same may be said with as much truth of the different forms of tenotomy of the internal rectus. Should one tenotomize this muscle to varying degrees or use some modification as the method of Blascovics, the Jameson recession or some of its modifications? When a decided effect on the internus is desired, some form of scleral anchorage is much safer than a tenotomy, which leaves the tendon so free that its later attachment to the globe is very problematic and occasionally has failed entirely. None of the operations for aiding an externus or limiting the action of an internus does in any way change the principles of the operation; but they are variations in technic with the object of gaining the same effect in a somewhat different manner.

I was privileged to hear a remark, made by John O. McReynolds, of Dallas, Texas, some years ago in an operating room. He said: "Every ophthalmologist who has had insomnia has devised a new operation for

convergent strabismus, and furthermore, every ophthalmologist at some time has had insomnia." This remark was made fifteen years ago—there have been many wakeful nights since.

What procedure should one adopt then? It is much better to choose any procedure and then perfect one's technic. If in doing this one more or less stitch seems indicated, that modification scarcely justifies adding a new name to the already long list of operations. This holds true of the procedure whether on the external or on the internal rectus.

When should one operate? Irrespective of age, strabismus should be corrected by operation when no reduction or an insufficient reduction is obtained by nonoperative means. The varieties of strabismus are so numerous that each case should be a study in itself to determine if possible all the factors, both principal and contributing.

FACTORS IN CONVERGENT STRABISMUS

Ametropia.—The kind and amount of ametropia should be carefully determined. If the patient is hypermetropic, the effect of correction of this condition on the amount of the deviation for distant and near vision should be determined. When the more unusual myopia is found, the effect of the myopic lens should be determined. The fact that ametropia is present does not preclude the presence of an involvement of the individual muscles; when one anomaly is present a second is quite commonly found. Hence the screen comitance test should be made in the six cardinal fields and the deviation measured in each field by prisms. Often when so measured a vertical deviation not observed in the eyes at front position is readily seen in the upper or lower corners. This test should be made without the glasses to avoid the prism that might be produced by looking through the glasses obliquely. A confrère recently asked if the hyperphoria observed after an operation on the lateral muscle was not due to a faulty placing of sutures in an advancement or a recession. This is possible, but I believe that such an error seldom occurs with experienced operators. It is more probable that the convergent strabismus was so marked that a vertical deviation was overlooked. This is most commonly seen in the double hyperphoria due to a paralysis of both superior or inferior recti. When the double hyperphoria is about equal it may be quite high and still not be observed in the primary position, being brought out only when the test is made in the upper and lower corners; in the lesser amounts of hyperphoria, it is quite impossible to determine the presence of the hyperphoria until such a test is made. A hyperphoria or hypertropia of one eye or a double hyperphoria in which that on one side is decidedly greater than that on the other is more easily observed in the primary position when the esotropia (or esophoria) is corrected by prisms, base out.

Another statement often made is that for the correction of a squint a muscle should be advanced or receded 1 mm. for a certain number of degrees of squint. This is an estimate to be disregarded more often than relied on because it fails to take into account the contributing factors in the squint. The muscle to be operated on and the amount of correction to be obtained can best be judged by observing the character of the excursions, their extent, the extent and character of the abduction and adduction and whether a coexisting vertical squint should be corrected before the convergent strabismus is attacked. In doubtful cases it may often be wise to expose two muscles before operating on either, especially if the first muscle exposed does not appear to be as much at fault as was first believed. If it appears the more responsible for the condition, especially when a patient is under a general anesthetic,

Fig. 1.—Position of the eyes at 9 months.

it is at times better to go no further until the effect of the operation on the first muscle is determined. A case of this kind was observed in July 1933.

The patient was a male infant, aged 20 months. The eyes crossed at birth. The hypermetropia was 1.50 diopters. The child was seen first at 9 months, when the pupil of the right eye was almost constantly at the inner canthus (fig. 1). No test at any time before the operation could bring the eye beyond the midpoint; usually that point was not reached. There was a fairly marked inversion in adduction. One got the impression that the eye might abduct better if it were allowed to do so. The strabismus measured from 80 to 90 degrees by the Herschberg test. When the internal rectus was exposed it was found to be very strong and large, resisting the hook even under ether anesthesia but still not giving the feel of a fibrous band such as is found in a retraction syndrome or a strabismus fixus. The muscle was receded to the equator. Since this muscle seemed responsible, the external rectus was not exposed. On the following day the eye could be abducted to the outer canthus and this result continued when the patient was seen two months later (fig. 2). One year later there was orthophoria by screen test, and the eye could be adducted to the inner and abducted to the outer canthus (fig. 3).

If one had continued and advanced the external rectus, as seemed necessary for the correction of so large an amount of squint, an overcorrection would without doubt have resulted.

It is necessary, then, to consider all the elements that may contribute to the strabismus, and when one condition is found to be

Fig. 2.—Position of the eyes after operation.

Fig. 3.—A photograph taken one year later with the eye on which operation was performed in extreme abduction.

present, to examine more carefully whether other elements may not be present also.

The factors most commonly concerned in a convergent strabismus and the points to be considered before operating are: (1) hypermetropia, (2) overacting internal recti, (3) underacting external recti, (4) the amount and character of the convergence near point and (5) vertical deviations.

Hypermetropia.—The amount of the hypermetropia should be determined under a cycloplegic, preferably atropine in younger children. It should be noted whether the cycloplegic reduces the amount of deviation to any considerable degree. If the amount of deviation for both distant and near vision is definitely reduced by either the plus lenses or the cycloplegic, other factors being ruled out, the squint is of the convergence excess type. A recession of both interni is usually indicated in such cases when lenses and orthoptic treatment fail to correct the deviation. The greater the effect of the plus lenses, the less the recession; the less the effect, the greater should the recession be. In a young patient if the lenses correct half of the deviation, it seems wise to correct slightly more than half the deviation by operation, leaving from 5 to 15 degrees of deviation to be corrected by the lenses. Not infrequently one sees cases in which the correction has been so complete that any plus lens produces a divergence.

The more possible it is to have the patient leave off lenses after the operation, the greater the amount of deviation which should be corrected by operation. It should always be borne in mind that a slight overcorrection is much more disfiguring than an undercorrection of from 5 to 15 degrees.

Overacting Internal Recti.—When there is a spasmodic inversion in adduction, even when the deviation measures nearly as much for distant as for near vision, a double recession is indicated, supplemented if necessary by some operation to aid the external muscle.

Underacting External Recti.—In these cases the deviation measures about as much for distant as for near vision. Excursion tests show a limited abduction often with a nystagmoid movement. In alternating strabismus this may be observed in both recti externi. A shortening of both externi is indicated, supplemented by a recession, if necessary, unless the convergence near point is remote, in which case the interni should not be operated on.

Amount and Character of the Convergence Near Point.—This should be observed very carefully. The more remote the PcB,[1] the less the internal muscles should be weakened, and when the PcB is 90 mm. or over the correction should be attempted by operating on the external muscles only.

Vertical Deviations.—These should always be looked for, as they are frequently found in convergence strabismus and often, even in cases of moderately high hypermetropia, are the main cause of the squint.

1. PcB means the convergence near point measured from the intracentral base line.

These conditions have been dealt with in a previous article,[2] but it may be said here that, in the main, vertical deviations should be corrected first, except in cases in which the lateral strabismus is much greater than the vertical and is not lessened by a prismatic correction of the vertical deviation in making tests.

In monocular squints, especially when one eye is more or less amblyopic, for the peace of mind of the family, the operation should at first be confined to the amblyopic eye and a satisfactory cosmetic effect achieved on this eye if possible, but if a resection has to be so marked as to cause pain or a drawn feeling later on, or if an internal muscle has to be receded so far as to cause much failure in adduction, or if there is a remote PcB, a sunken caruncle or the appearance of a greater distance from the limbus to the center of the nose than there is on the other side, it is much better to do less on the amblyopic eye and get some of the effect on the good eye. This, of course, should be done at a subsequent procedure, except when the operation is performed under a local anesthetic and the further procedure is definitely indicated.

I believe that all the discussion over the proper operation for convergent strabismus is due to the failure to classify the cases properly before operation, and the fact that it is so easy to be mistaken is the more reason why, in doubtful cases, both the externus and the internus should be exposed before operation is performed on either muscle.

The essential points to be considered are: (1) the amount of hypermetropia and the effect of its correction on the deviation; (2) the amount of deviation for distant and near vision and in the six cardinal fields; (3) the amount and character of the abduction and adduction determined by the screen comitance test; (4) the relative importance of an existing vertical deviation, also determined by the screen comitance test; (5) the amount and character of the convergence near point.

After these points are thoroughly studied, the experienced operator may state that an internus should be receded or an externus advanced a certain number of millimeters, and that is really what one does, but to base the operative procedure on the number of degrees of deviation alone is unreliable and unsatisfactory, leads to disappointment in operative results and is one cause for the multiplicity of operative procedures.

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BINOCULAR BRIGHTNESS SUMMATION IN DARK ADAPTATION

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Although Piper [1a] and others, including Behr,[2] Cook,[3] DeSilva and Bartley,[4] Messmer [5] and Stargardt,[6] reported the presence of brightness summation in binocular vision, particularly under conditions of dark adaptation, some investigators either have failed to find evidence for summation or have attempted to explain the lower binocular thresholds of sensitivity to brightness without reference to central neural activity. Among the latter are: Müller,[7] who accounted for lower binocular thresholds assuming that binocular judgments are more easily made; Sherrington,[8] who worked with monocular and binocular flicker effects and found no summation, and Lohmann,[9] who believed that lower binocular thresholds could be explained by the increase in the retinal areas involved when both eyes were used. Others who reported no summation include Abney and Watson,[10] Best [11] and Graham.[12] That

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the various studies have not been in agreement is due largely to variation in experimental procedure and failure to control conditions so as to reduce errors of measurement.

The semidecussation of the fibers from peripheral retinal areas, giving homolateral representation in postchiasmal regions, makes it simple to arrange light stimuli to affect either identical or nonidentical central parts. In order to make comparative measurements of monocular and binocular threshold sensitivity to light, special screens were placed against the test surface of a Nagel adaptometer [13] to provide 2 degree stimuli 10 degrees from the point of fixation. Three removable slides placed between the observer's headrest and the stimuli made it possible to use binocular or monocular stimulation without interfering with binocular foveal fixation of the illuminated red cross in the center of the field of vision and without informing the observer whether he was observing with both eyes or with only one. Twenty-five minutes' dark adaptation preceded each observation period.[14] Discrete stimulus values, with short exposures (two and five-tenths seconds), in ascending series, were found to give results which were statistically more reliable than those obtained by the usual method of continuous increase in the intensity of the stimulus. The observers were required to give a positive report when light, not stimulus form, was first visible. The short exposures eliminated fatigue, reduced movements of the eyes, and prevented possible adaptation to subliminal stimulation. From three to nine trials, with regular increases in intensity of the stimulus, composed each series; the average intensity value of positive reports in twenty-five series was used as the threshold. Results for five observers are presented in table 1. The retinal regions tested for monocular thresholds are indicated; binocular values were obtained from stimulation of corresponding points of the two eyes. Individual differences are evident, but summation, as shown by the lower binocular thresholds, is present for each observer. The binocular intensity values are, on the average, about 30 per cent lower than the monocular values.

Additional tests were made, using two 2 degree light spots, one on each side of the visual field, stimulating noncorresponding retinal

13. For a description of the Nagel adaptometer, the standard instrument for measuring light sensitivity, see von Helmholtz: A Treatise on Physiological Optics, ed. 3, edited by J. P. C. Southall, Ithaca, N. Y.: Optical Society of America, 1924, vol. 2, p. 315. The Macbeth illuminometer was used to obtain a correction factor for converting the scale values of the adaptometer into absolute intensities in millilamberts.

14. Blanchard, J.: The Brightness Sensibility of the Retina, Physical Rev. **11**:81, 1918. The writer gives a table of pupillary size as influenced by changes in illumination, but since threshold sensitivity under dark adaptation is well below the lowest intensity included in the table (0.00015 millilambert), it is not likely that there are significant changes in pupillary size under complete dark adaptation.

regions. No summation was demonstrated when the nasal and temporal regions of the two eyes (nonidentical areas) were stimulated simultaneously, or when two sides of the same retina were stimulated. When both stimuli were exposed to corresponding points of the two eyes, there was again a 30 per cent reduction in threshold intensity, giving evidence of central summation for binocular stimulation of corresponding points.

The inverse relationship between the size of the stimulus and the threshold intensity [15] for scotopic vision was evident in tests made with stimuli larger or smaller than 2 degrees. Average results for monocular and binocular thresholds for light stimuli of 1, 2, 4 and 8 degrees' visual angle, presented in table 2, demonstrate summation, as

TABLE 1.—*Threshold Values for Light Stimuli of 2 Degrees' Visual Angle* *

	Retinal Regions Stimulated					
Observer	Left Temporal	Right Nasal	Binocular	Left Nasal	Right Temporal	Binocular
1	296	340	240	360	324	272
2	776	684	484	736	814	592
3	620	616	428	1,120	904	788
4	436	412	230	416	472	264
5	436	408	276	456	544	318
Average	512	492	331	617	611	446

* The values in the tables may be converted to millilamberts by multiplying by 4.78×10^{-9}

TABLE 2.—*Average Threshold Values for Three Observers for Stimuli of 1, 2, 4 and 8 Degrees' Visual Angle*

	Angular Diameter			
	1	2	4	8
Monocular	1,950	564	281	215
Binocular	1,238	384	189	135

shown by the lower binocular values for each size of stimulus. The absolute difference between monocular and binocular thresholds becomes progressively smaller as the angular size of the stimulus is increased. For this reason, differences between the thresholds might be less readily measured for large areas. This may account for the frequent report that summation is present only for stimuli of minimal area.

Lower binocular thresholds have been attributed by Müller [7] to "greater ease" of binocular observation, but under conditions in which binocular fixation is used this would not suffice to explain a significant reduction in the binocular threshold; binocular summation more likely contributes to greater ease of observation when both eyes are used.

15. Adams, D.: Dark Adaptation, Medical Research Council, Special Report Series, no. 127, London, His Majesty's Stationery Office, 1929. For a summary of the work on the size of the stimulus and threshold intensity, see page 57.

Although under normal conditions there is usually superiority of binocular acuity, the measurements made under conditions of advanced dark adaptation, with peripheral stimulation, probably involve photochemical sensitivity rather than resolving power of the eye.

Various investigators, including Hecht,[16] have emphasized the significance of the number of excited retinal elements in visual functions. Hecht used this as a basis for the explanation of acuity as a function of illumination, differences in intensity being assumed to be correlated with differences in the number of activated retinal elements. Lohmann [9] suggested that binocular stimulation may result in the excitation of nonidentical retinal regions, which would be equivalent to an increase in the area of stimulus (or in the number of excited retinal elements) and should thus account for lower binocular thresholds. This hypothesis would imply that, centrally, stimulation of nonidentical rather than identical regions mediates lower thresholds. It has been shown, however, that summation does not occur unless corresponding retinal regions, which are assumed to excite identical or nearly identical central areas, are stimulated.

The decrease in threshold intensity accompanying the increase in the area of stimulus, demonstrated by Piper [1b] and others, was found also by Adrian and Matthews [17] in studies of action currents in the excised eyes of eels. An increase in area is equivalent to raising the intensity of the stimulus. Impulses may be summated on the way to the optic nerve, an effect described by Granit [18] as synaptic reaction, or "spatial summation" effected through horizontal cells, amacrines and cells of the ganglionic layer. Granit defined such summative effects as "the physiologic expression of the anatomic convergence of a number of paths to a common neuron." It seems possible that the summation resulting from binocular stimulation is likewise to be explained on the basis of the union of impulses from several regions. It is certain that the summative effects demonstrated for binocular stimulation cannot be accounted for without reference to the central regions involved.

The manner in which summation occurs remains a matter of speculation until more complete information concerning the combination of impulses within the central nervous system can be secured. If there is a spatial representation of peripheral retinal regions in the visual cortex or in subcortical areas, stimulation of corresponding retinal points, resulting in concentration of central excitation effected through divergent peripheral regions, may account for summation.

16. Hecht, S.: The Nature of the Photoreceptor Processes, in The Foundations of Experimental Psychology, Worcester, Mass., Clark University Press, 1929.

17. Adrian, E. D., and Matthews, R.: The Action of Light on the Eye, J. Physiol. **63**:378, 1927.

18. Granit, R.: The Retina as a Nervous Center, Arch. Ophth. **6**:104 (July) 1931.

RETINAL DETACHMENTS

CLINICAL EXPERIENCES WITH THE DIATHERMIC TREATMENT

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This is a report of personal experiences with the diathermic treatment in a series of twenty-three cases of retinal detachment. It is not the purpose in this report to emphasize the percentage of good results. The matter is beyond that stage, for no one who has had experience with the diathermic treatment has any doubt as to its efficacy in suitable cases. At the present stage, one's effort should be rather to discover why one gets good results in some cases, and why one fails in other cases. If and when one can solve this problem one will be able to select cases and operate only in those which present definite indications.

The failures, more instructive than the successes, are given a more prominent place in this report. The case reports contain only the most essential data. The physical condition, the question of syphilis and tuberculosis, the problem of foci of infection, and anything that may have had a bearing on the patient's ocular trouble, although they were investigated, are not mentioned unless the findings were positive. To obviate the tedium of a lengthy paper, the various diagnostic and technical details and the difficulties met with in some of the cases of retinal detachment are not discussed here. For the same reason the charts of the fields of vision have been omitted.

In this series of twenty-three cases, fourteen are to be considered as successes and nine as failures.

THE NINE FAILURES

Although each of the nine failures carries its own interesting lesson, lack of space compels me to mention the histories of only three of them.

CASE 4.—E. B., a girl aged 9 years, had bilateral detachment of the retina and high myopia.

History.—She came to the clinic of the Herman Knapp Memorial Eye Hospital on Feb. 18, 1933, stating that her vision failed quite rapidly in the left eye during the month of December 1932. The retina was totally detached and it had two large tears. Vision, right, was 20/70; left, perception of hand movement. After a consultation with several colleagues the opinion prevailed that on account of the age of the patient, precluding absolute immobility after the operation, she should not be operated on.

Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 13, 1934.

On July 17, the patient returned with a retinal detachment in the right eye. Vision was: right, hand movement; left, barely light perception. The vitreous was almost opaque on account of an exudate in it. After she had stayed in the hospital only a few days, during which she was kept very quiet in bed, the vitreous cleared up sufficiently to allow a better ophthalmoscopic examination. The vision gradually improved to 20/200, and long black strands were seen in the nasal portion of the vitreous.

On July 29, a large tear was discovered in the upper nasal quadrant. The retina was detached in that sector. This tear had developed during the previous twenty-four hours, while the patient kept very quietly in bed. On August 3, the detachment had extended a little more (between 11 and 3 o'clock, fig. 1 *A*).

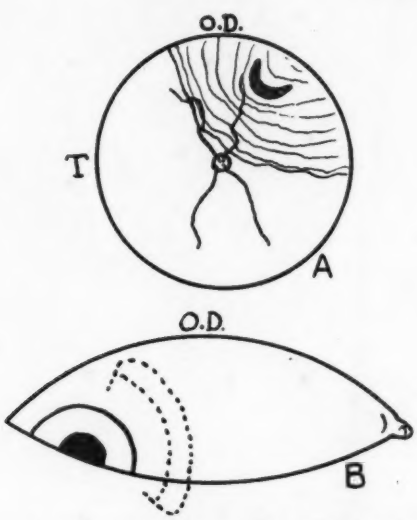

Fig. 1 (case 4).—*A*, retinal detachment and tear between 11 and 3 o'clock (*T*, temporal); *B*, two rows of diathermic punctures between 12 and 4 o'clock 14 and 17 mm. from the limbus corneae.

First Operation.—The operation was performed under local anesthesia. Two rows of punctures were applied, parallel with the limbus corneae, between 12 and 4 o'clock at a distance of 14 and 17 mm. from the limbus (fig. 1 *B*).

On September 5, when the patient was discharged, vision, right, was limited to counting fingers at 6 feet (183 cm.). The vitreous was not sufficiently transparent to allow an ophthalmoscopic examination.

On December 23, the vitreous was clear. The retina was detached in the lower portion of the fundus; it appeared thinned out and transparent with an irregular tear between 5 and 7 o'clock. The upper part of the fundus between 12 and 1 o'clock showed an area of pigmentation near the ora serrata, and the region corresponding to the location of the former tear presented two gray patches of coagulated retina.

In view of the fact that the detachment tended to extend and the tear was becoming larger by the confluence of the numerous small thin areas even while the patient was kept very quietly in bed, a second operation was decided on.

Second Operation.—The second operation was performed on December 30. Five applications of a 7 prong electrode were made below between 3:30 and 6:30 o'clock, at a distance of 18 mm. behind the limbus corneae. In addition, 10 single punctures were made between the meridians of 6 and 7:30 o'clock. Subretinal fluid escaped only during three of the applications.

On Jan. 8, 1934, the right eye was quiet; a hyphemia was present in the lower portion of the anterior chamber; the tension was normal. The fundus reflex was good.

On January 11, there was no fundus reflex. The patient complained of not seeing even light. During the following weeks the blood was resorbed from the anterior chamber and vitreous.

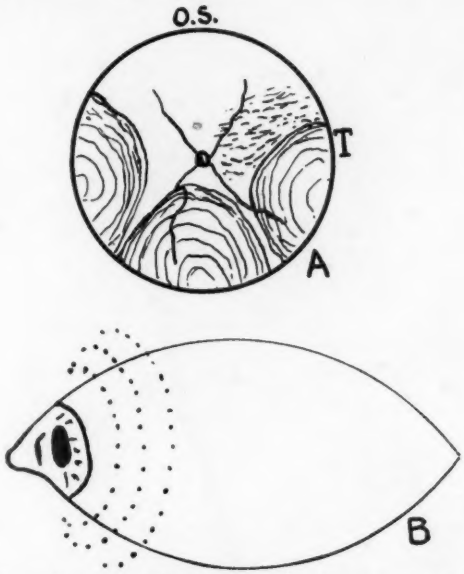

Fig. 2 (case 7).—*A*, retinal detachment; *B*, three rows of micropunctures 8, 10 and 13 mm. behind and parallel with the limbus, from 6 to 1 o'clock on the temporal side (*T*).

On March 10, the vitreous was clear. The retina was detached below; there was a hemorrhagic patch on the retina in the lower temporal sector. Vision in the right eye was limited to counting fingers at 3 feet (91 cm.).

CASE 7.—S. K., a man aged 35, a merchant, had aphakia and retinal detachment in the left eye and aphakia and secondary glaucoma in the right.

History.—Twelve years ago he had both lenses removed on account of high myopia. Two years ago (April 1932) the right eye became hard and was operated on for glaucoma. Soon after the operation the vision failed almost entirely in that eye. The left eye had always been the poorer eye, but it had become "almost blind" a few months previous to his first call at my office. He had bumped his nose a few weeks before. Vision, right, was the equivalent of counting fingers temporally at 20 cm.; left, counting fingers at 40 cm. The right fundus presented an atrophic cupped optic disk; the left fundus, in addition to an atrophic disk, had a retinal detachment occupying its lower half (fig. 2 *A*).

First Operation.—On March 3, 1933, three rows of micropunctures were applied, 8, 10 and 13 mm. behind and parallel with the limbus, extending from 6 o'clock on the temporal side up to 1 o'clock (fig. 2 *B*). The result was unsatisfactory.

Second Operation.—On June 3, the fundus appeared practically the same as before the first operation. Four single punctures were applied below nasally and six below and temporally. Very little fluid escaped. A very slight improvement of vision resulted: from hand movement to counting fingers at 25 cm. in the lower field. A portion of the nasal side of the retina was reattached, but on the temporal side the condition remained unchanged.

Third Operation.—On June 22, two rows of punctures were applied on the temporal side, 10 and 14 mm. behind the limbus, between 12 and 6 o'clock. Since

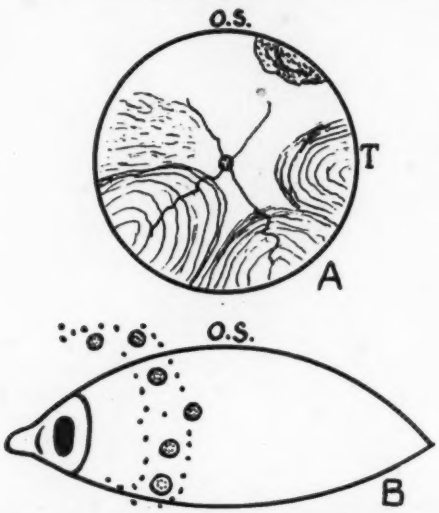

Fig. 3 (case 8).—*A*, retinal detachment and patch of choroiditis; *B*, application of six 6 prong electrodes between 12 and 4 o'clock, from 13 to 16 mm. behind the limbus and several single punctures in front and behind the pluripunctures.

very little subretinal fluid escaped, a sclerotomy was performed with a Graefe knife. The result remained as unsatisfactory as after the first two operations. Later on another ophthalmologist tried several more operations, but he did not succeed either.

This case is one of a group of retinal detachments in aphakic eyes which, in the majority of cases, do not respond to this treatment. Why these failures? Is it because of the difficulty of examining the entire fundus in aphakia? Are these cases different from other cases? Did the consistency of the subretinal fluid prevent the reattachment of the retina?

Case 8.—B. L., a woman aged 40, married, had retinal detachment in the left eye and high myopia in both eyes.

History.—She came for consultation on Nov. 25, 1933. Three weeks previously the vision became blurred in the upper nasal field of the left eye. Vision, right was 20/70, with —15 sphere; left, counting fingers at 30 cm. The field of vision was present only in a small area below. No tear was visible. Assuming that a

tear was present in the upper temporal sector in the region where there was a patch of choroiditis, I decided to make the diathermic applications in that location (fig. 3 *A*).

First Operation.—On December 2, the sclera was exposed in the temporal half of the eyeball and six 6 prong electrodes were applied between 12 and 4 o'clock, from 13 to 16 mm. behind the limbus. In addition, several single punctures were made in front and behind these pluripunctures (fig. 3 *B*). The result was that the retina reattached in the upper temporal sector and the vision improved to 15/200 with —12 sph. —3 cyl., axis 135. The field became complete.

TABLE 1.—*Table of Failures*

Case	Age, Yrs.	Sex	Eye	Refractive Error	Duration of Detachment	Vision Before Operation	Vision After Operation	No. of Operations	Comment
1	35	M	R.	Emmetropia	5 months	20/200	15/200	3	Returned to work (laborer) too soon after operation
2	18	F	L.	High myopia	2 years (?)	L.: fingers at 1 foot (31 cm.)	L.: light perception	2	Degenerated retina with sieve-like appearance in lower half; opacities of lenses; brother blind from bilateral retinal detachment
3	25	M	R. and L.	Emmetropia	L.: 2 yrs. R.: 6 mos.	R.: fingers L.: 0	R.: fingers	2	Unruly, restless after operation
4	9	F	R. and L.	High myopia	R.: 1 mo. L.: 1 mo.	R.: hand movement L.: hand movement	R.: hand movement L.: hand movement	2	Malignant form, developing retinal tears during absolute rest in bed (see history)
5	24	F	R.	High myopia	3 months	Hand movement	Hand movement	2	Degenerated retina and vitreous
6	43	M	R.	High myopia	9 months	R.: fingers at 3 feet (91 cm.)	Fingers at 2 feet (61 cm.)	2	
7	35	M	L.	High myopia	6 months (?)	Hand movement temporally	Hand movement temporally	3	Aphakia in each eye, glaucoma (see history)
8	40	F	L.	High myopia	4 weeks	Fingers at 30 cm.	Fingers at 30 cm.	2	(See history)
9	61	M	L.	.....	.....	Hand movement	Hand movement	2	Aphakia

No mention is made of trauma as the cause of the detachment, since in most of the cases even the patient was not able to give definite information regarding this matter.

A few weeks after the operation vision failed again, and the macula became involved.

Second Operation.—On Jan. 16, 1934, a number of triple, double and single punctures were applied in the area between 4 and 8 o'clock along a line 16 mm. behind the ora serrata. Several single punctures were also made in the nasal superior sector between 9:30 and 10:30 o'clock, about 15 mm. behind the limbus. There was considerable loss of subretinal fluid, especially after the lower set of punctures.

The result remained unsatisfactory. The retina did not reattach. Vision and the field of vision were not improved.

COMMENT

In some of the nine failures the patients had very little chance to get well on account of the long duration of the detachment with the usual accompaniments (degenerated condition of the retina and vitreous).

In two cases of aphakia the periphery of the fundus could not be examined properly, and in others there was a lack of cooperation after operation. In a case of total failure, the patient had a recurrence because he returned to hard work too soon after operation. In case 9 the patient vomited the night after operation (but so did other patients who made satisfactory recoveries). However, there is no doubt that besides poor judgment in selecting cases that are not suitable, besides making technical errors during the operation or having to deal with patients who do not cooperate, there are other less obvious reasons for some of the failures. The choroid may be so atrophic that it does not react to electrocoagulation or to any other measure directed toward producing an inflammatory reaction in the tissue. In support of this theory one may mention the extreme rarity of acute inflammatory processes of the choroid in patients with high myopia. (Ophthalmologists with a long and rich clinical experience can bear out the accuracy of this statement.) It is understandable why in the eye as well as in any other part of the body atrophied tissues are not the seat of inflammatory reactions—no matter what the etiologic factor may be: infectious, toxic or physical (like electrocoagulation).

In other cases the retina is degenerated and folded so that it cannot flatten out and return to its normal position in relation to the choroid. In some patients the failure may be attributed to the vitreous which, being adherent to some portions of the retina, prevents it from falling back into its normal position. Finally, the remaining subretinal fluid (not the entire subretinal fluid escapes during the operation) may not be resorbable and may prevent the reapplication of the retina to the underlying choroid.

That technical errors in performing the operation are an important cause of some of the failures is demonstrated by the fact that the second half of this series of cases contains a majority of the successes while most of the failures followed operations performed a few years ago. Diagnostic and operative details had to be gradually worked out; the type and intensity of the current, the make of the apparatus, the shape and length of the electrodes, the handle, etc., had to be developed and tested. As one became gradually acquainted with these details the successful results became more frequent and the percentage of cures higher.

CASES WITH REATTACHMENT OF THE RETINA

All one should expect to achieve by the surgical treatment of retinal detachments is a complete and permanent reattachment of the retina with a minimum of damage to the tissues of the eyeball.

If, on account of a hemorrhage or degenerative or inflammatory processes or amblyopia due to an old strabismus, etc., the central vision was more or less impaired before the appearance of the detachment, one cannot expect a good central visual result even if the operation has succeeded in replacing the retina in its normal position.

In fourteen cases the retina became reattached. In some of these cases, however, there were macular degenerative changes of long stand-

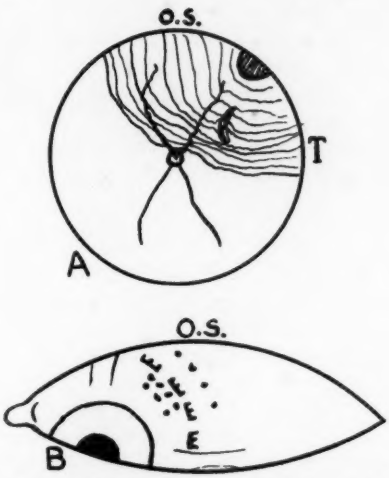

Fig. 4 (case 10).—*A*, retinal detachment and the tear between 1 and 2 o'clock; *B*, four 3 prong electrodes applied between the superior and external recti on a line parallel with and 16 mm. behind the corneal limbus, four single punctures about 2 mm. farther back and 7 punctures behind the ora serrata.

ing, and in others an active inflammatory process in the macular area prevented the restoration of good central vision; in one case there existed an amblyopia due to a convergent strabismus.

Only a few of these cases are reported here. Two tables summarize the entire series.

CASE 10.—B. L., a woman aged 62, had a retinal detachment in the left eye.

History.—The left eye became suddenly blind on June 22, 1933. The patient had been a sufferer from coronary thrombosis and asthma for several years. She had been coughing considerably. She came under my observation on June 27. In the right eye vision with + 50 sph. was 20/40; in the left eye, fingers temporally. She was admitted to the Herman Knapp Memorial Eye Hospital on June 29. The fundus showed a detachment of the upper half of the retina between 10 and

3:30 o'clock. A tear at the ora serrata was seen between 1 and 2 o'clock (fig. 4 *A*). The field of vision showed a defect corresponding to the extent of the detachment.

While the patient was kept in bed the vision improved slightly. She could not lie flat on her back and had to get up on account of asthma and cough. Owing to her incessant restlessness it was decided to postpone or even deny the advisability of the operation, and she was discharged on July 5. She returned on July 19 with the retina more detached and with her mind made up for an operation.

Operation.—On July 20, after the scleral surface of the eyeball was exposed in the upper temporal quadrant, four 3 prong electrodes were applied between the superior and external recti on a line parallel with and 16 mm. behind the corneal limbus. Since the ophthalmoscope revealed that the tear was just beyond this line, five single punctures were made about 2 mm. farther back (fig. 4 *B*).

I find in my notebook the following remarks written immediately after the operation: "I made two mistakes (*a*) I did not drain enough subretinal fluid. (*b*) I did not connect the rows of punctures with the region of the ora serrata." The patient could not keep quiet even during the first three or four days after the operation; she coughed, tossed around and sat up on account of her asthma.

On September 5, the ophthalmoscopic examination revealed a complete reattachment of the retina and a good field.

On October 23, her vision was 20/70. On February 19, 1934, vision in the left eye with —50 sph. was 20/50. There were some old foci of degeneration in the paramacular area.

CASE 12.—H. F., a man aged 36 years, a merchant, had a retinal detachment (traumatic) in the right eye and high myopia in both eyes.

History.—On Oct. 4, 1933, he bumped his head against a door. On October 11, the temporal field of vision of the right eye became obscured. On October 12, vision was, right, hand movement; left, with —9 sph. —1 cyl., axis 90, 20/40.

The right fundus showed a retinal detachment involving the lower half and the upper nasal quadrant, and two large tears and a few small holes in the lower nasal sector. Several small patches of old choroiditis were found scattered above and in the temporal region (fig. 5 *A*). The left fundus disclosed a few small patches of old choroiditis near the ora serrata at 11 and 6 o'clock.

Operations.—On October 17, the sclera was exposed on the nasal side between 2 and 6 o'clock as far back as 19 mm. from the limbus. One 7 prong electrode was applied 17 mm. behind the limbus at the 4:30 o'clock meridian. Some fluid escaped. A line of punctures was made concentric with the limbus, 17 mm. behind it and extending from 2 to 5 o'clock. The extremities of this line were then connected with the region of the ora serrata by two rows of micropunctures placed anteroposteriorly (fig. 5 *B*).

On October 21, the patient had the grip, and the eyes had to be left unbandaged on account of an acute conjunctivitis and superficial infiltration of the cornea. Ten days later it was found that the retina was still detached in the lower nasal and part of the upper nasal quadrant of the fundus. The condition became worse during the next two weeks, and on November 11 the retina was as much detached as it had been before the operation. On that day a second operation was performed. This time the punctures were applied 22 mm. behind the limbus as indicated in figure 5 *C*. The conjunctiva was dissected on the nasal side between 2 and 5:30 o'clock. There was considerable bleeding from granulation tissue. A 7 prong electrode was applied.

The patient was discharged on December 10 with vision of 20/70 in the right eye, and the retina was completely reattached. On December 24, vision in the right eye with —11. sph. —3 cyl., axis 100, was 20/50; on Jan. 7, 1934, it was 20/30 with correction; on February 25, 20/30+. The field was normal.

CASE 13.—T. O'N., a boy aged 12 years, had a traumatic retinal detachment in the left eye.

History.—He was struck with an apple in the left eye during the last week of August 1933. On September 1, he had been operated on (by another ophthalmologist) for a retinal detachment located in the lower part of the fundus. Though

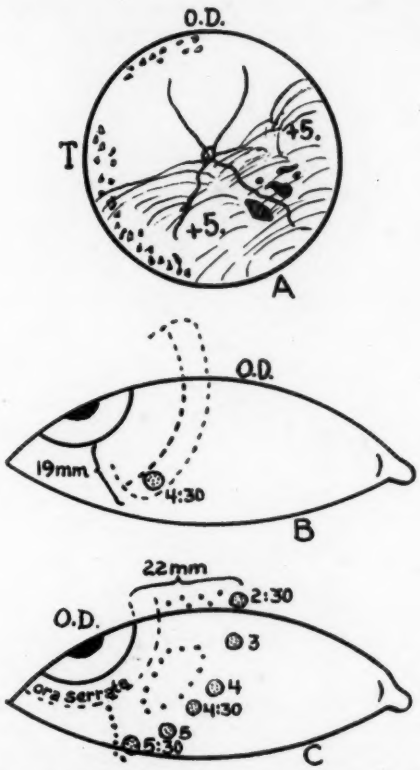

Fig. 5 (case 12).—*A*, retinal detachment, two large holes and a few small holes in the lower fundus and nasally, also patches of old choroiditis in the temporal region (*T*); *B*, location of diathermic punctures at first operation (see text); *C*, location of punctures at second operation.

the retina remained detached after the operation the vision improved from counting fingers to 20/70. When this patient came under my observation his vision was: right, 20/20 and, left, 20/70. Tension in the left eye was slightly minus. There still was a tear at the ora serrata between 5 and 7 o'clock (fig. 6 *A*).

Since the diathermic applications had not been made far enough back to encircle the area with the tear, a second operation was decided on.

Operation.—On November 23, under avertin-ether anesthesia (the only patient in this series operated on under general anesthesia), the sclera was exposed over an

area 16 mm. behind the limbus on the lower half of the eyeball. Punctures were made as follows: (1) a 6 point electrode was applied 16 mm. behind the limbus at 5, 4, 6 (beneath the inferior rectus) and 3 o'clock (beneath the external rectus); (2) two rows of single punctures were made parallel with the limbus corneae. A moderate amount of subretinal fluid escaped (fig. 6 *B*).

On December 4, the ophthalmoscopic examination revealed an unusual picture: Just below the macula was an oblong, grayish-white, bulging area about 2 disk diameters long and 1 disk diameter wide. The retinal blood vessels were present in the superficial layers of the elevation. No pigment was present. The periphery of the fundus showed the usual diathermic reaction. This bulging, white area was considered as coagulated retina. In the course of time the white mass flattened out and left behind a coarsely pigmented patch. I doubt that the coagulation

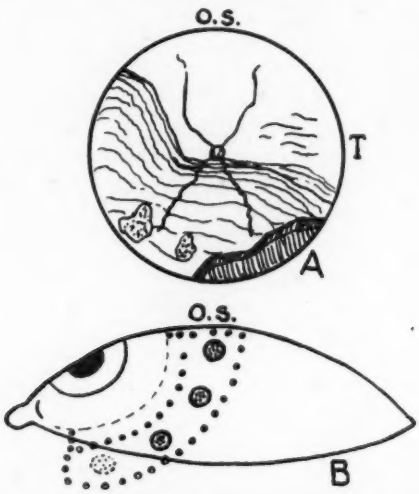

Fig. 6 (case 13).—*A*, retinal detachment; tear at the ora serrata between 5 and 6 o'clock; *B*, application of 6 point electrodes 16 mm. behind the limbus at 5, 4, 6 and 3 o'clock, and two rows of single punctures parallel with the limbus.

was produced by a diathermic puncture. The ophthalmoscopic picture of micropunctures is characteristic and of a different appearance from the picture seen in this patient. Was it then due to a *distant* effect of the diathermic current—leaping across the vitreous to that region below the macula? The answer remains to be given after more cases of this sort are reported.

On December 14, the patient was discharged with the retina reattached and vision in the left eye equal to 20/70.

On March 27, 1934, vision in the left eye was 20/50. The fundus showed an area of choroidal atrophy in the lower temporal quadrant, and the field was defective above and nasally, as was to be expected. At the last examination vision was 20/40+.

Case 14.—L. T., a woman, aged 23, a filing clerk, had a retinal detachment (traumatic) in the left eye and high myopia in both eyes.

History.—On Dec. 25, 1931, vision became blurred in the left eye. She gave a history of having bumped her head four weeks previously. On Jan. 11, 1932,

vision right, with —16 sph. was 20/100++; left, counting fingers at 2 feet (61 cm.). The fundus of the left eye showed the retina detached over the lower two thirds (fig. 7 *A*). The left eye had always been the poorer eye. The field showed the characteristic defect corresponding to the detached retina.

Operation (*Guist*).—On Feb. 11, 1932, the sclera was exposed over the entire half of the eyeball between the internal and external recti. Thirteen trephinings were performed, and each area of exposed choroid was cauterized with the electrocautery for a part of a second. Three areas were perforated to allow the escape of subretinal fluid. About 1 cc. of fluid escaped. The tension remained good during the operation (fig. 7 *B*).

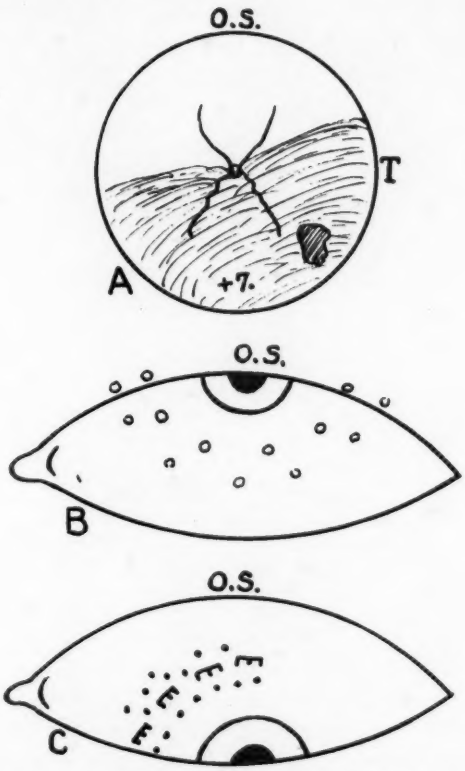

Fig. 7 (case 14).—*A*, retinal detachment; *B*, thirteen trephinings at first operation; *C*, application of 3 prong electrodes and single micropunctures at second operation.

On March 1, vision on the left was 20/200. The retina reattached. The field became normal.

On November 20, the patient returned with a recurrence of the detachment, the latter occupying the nasal half of the fundus. No tear was visible. This time the diathermic treatment was used.

It was thought that there must be a tear near the ora serrata above and nasally, and a number of 3 prong electrodes were applied 11 mm. behind the limbus in the

upper nasal sector and underneath the superior rectus. Several single micropunctures were also applied (fig. 7 *C*).

The retina became reattached. Vision at the last examination (Feb. 24, 1934) was: left, with —15 sph. —1: 50 cyl., axis 130, 20/100+. There were a few foci of degeneration in the macular area (of old standing).

CASE 16.—J. B., a young man aged 20, a student, had a traumatic retinal detachment and a choroidal hemorrhage in the macular region of the right eye.

History.—On Sept. 23, 1933, he was struck in the right eye with a baseball. He was treated at another hospital, where a diagnosis of hemorrhage in the macular area was made. On November 9, he noticed a dark curtain obscuring the upper part of the field of vision. When first seen at the clinic of the Herman

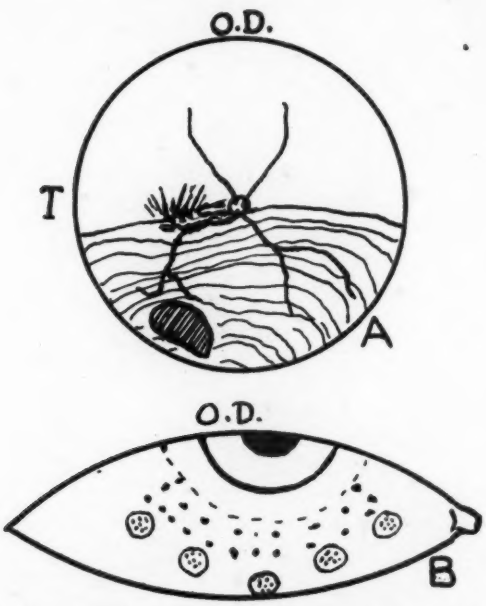

Fig. 8 (case 16).—*A,* retinal detachment and tear; also fan-shaped grouping of retinal striae; *B,* application of five 7 point electrodes between 7:30 and 5 o'clock, and about twenty-two single micropunctures, parallel with the ora serrata.

Knapp Memorial Eye Hospital on November 27, he had a retinal detachment involving the lower half of the fundus of the right eye, with a tear at the ora serrata between the 6 and 7 o'clock meridians. The detachment extended beyond the lower part of the macula leaving, however, a portion of the upper part uncovered. On this portion of the macula one could see a fan-shaped grouping of retinal striae. The field showed a defect corresponding to the extent of the detachment. Vision on the right was 15/200; on the left, 20/40 (fig. 8 *A*).

Operation.—On November 28, five applications of the 7 point electrode were made below in an arc about 13 mm. behind and parallel with the ora serrata between the 7:30 and 5 o'clock meridians. About fifteen single micropunctures were made in the zone between the multiple punctures and the ora serrata (fig. 8 *B*).

Examination of the fundus after the operation showed four coagulated areas in the lower part of the fundus and a retinal hemorrhage below. An ophthalmoscopic examination on November 30 revealed the retina reattached except in the 7 o'clock meridian, where there was a grayish bulging area. The coagulated foci were seen as distinct yellowish-white spots. A few hemorrhagic spots were noted in the retina. No tear was visible.

On December 19, when the first careful examination of the fundus could be made, the macular area was seen to bulge about 1½ diopters. Its surface had a marmorated appearance, alternating dark and light gray. The lower temporal vein dipped into this bulging mass. Vision in the right eye with —1 sph. —1 cyl., axis 160, was 20/200. In the remainder of the fundus the retina was completely reattached.

On Feb. 27, 1934, the macular elevation appeared less smooth and presented numerous shiny crystals. This elevation seemed to be connected with the optic

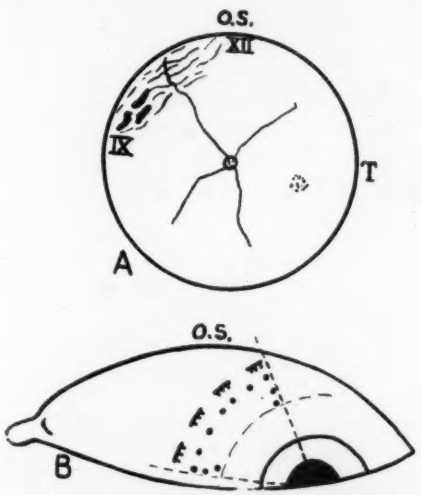

Fig. 9 (case 19).—*A*, flat detachment of the retina with a few foci of recent choroiditis; *B*, applications of 3 point electrodes from 11 to 9:30 o'clock 15 mm. behind the limbus and single punctures.

disk by a bridge of hazy grayish retina. There was a small pigmented patch of choroidal atrophy adjoining the nasal margin of the disk and not far from it in the vitreous three or four clusters of pigment, each cluster surrounding a small irregular triangular opacity of vitreous. I interpret these changes (in the macula as well as near the disk) to be the result of choroidal hemorrhages produced by the original trauma. Vision in the right eye was 20/200. The retina was attached completely.

The field of vision was good all around, except for the central area which showed a large central scotoma connected by a bridge with the blind spot.

CASE 19.—D. A., a man aged 67, a lawyer, showed incipient retinal detachment (traumatic).

History.—On Dec. 14, 1933, he fell and struck the left side of the head. He bled from both nostrils and had ecchymosis of the left conjunctiva bulbi. On Jan. 1, 1934, he began to see scintillations in the lower temporal field of the left

TABLE 2.—*Cases in Which the Retina Was Reattached*

Case	Age, Yrs.	Sex	Eye	Refractive Error	Duration of Detachment Before Operation	Vision Before Operation	Vision After Operation	Operations	Macular Changes	Comment
10	62	F	L.	Low myopia	1 mo.	Hand movement temporally	20/50	1	Faint	Cardiac asthma; restlessness
11	17	F	R.	Moderate myopia	8 mos.	2/200	20/200	1	Present	
12	36	M	R.	High myopia	2 wks.	Hand movement	20/30+	2	None	Due to acute rhinitis and conjunctivitis after the first operation, eye had to be left open, and retina detached again
13	12	M	R.	Low myopia	3 wks.	20/70	20/40	2	Coagulated retina near macula	
14	23	F	L.	High myopia	2 mos.	Hand movement	20/100+	2	Yes	Recurrence of detachment several months after the first operation (trauma)
15	62	M	L.	Moderate myopia	2 mos.	10/200	20/200	1	Yes	Larsson method
16	20	M	R.	Low myopia	2 mos.	15/200	20/100	1	Yes	Macular exudate was present before the operation
17	33	M	R.	.....	2 wks.	Hand movement	15/200	1	Yes	Tuberculous chorioretinitis
18	49	F	L.	Moderate myopia	2 mos.	Hand movement	3/200	2	Yes	
19	67	M	L.	High myopia	1 mo.	20/50	20/15	1	.....	Tuberculosis of lungs, myocarditis, chronic nephritis
20	69	M	R.	.....	3 mos.	Hand movement	15/200	1	.....	Amblyopia due to right convergence strabismus since childhood
21	45	F	L.	.....	2 mos.	Hand movement	20/40	1		
22	47	F	L.	Moderate myopia	2 mos.	Fingers at 15 cm. below	20/200+	2	Vitreous turbid	Tuberculosis, choroiditis and phlebitis; this case will be reported in full later
23	69	F	R.	.....	2 wks.	Hand movement below	20/70	1		

eye. He had pulmonary tuberculosis, nephritis and arteriosclerotic heart disease. He was admitted to the Herman Knapp Memorial Eye Hospital on February 1.

Vision in the right eye with —50 sph., axis 50 was 20/25; in the left with —5 sph., 20/50.

Examination of the fundus revealed a flat detachment of the retina with a few foci of recent choroiditis situated between 9 and 11:30 o'clock and extending from the ora serrata to 7 mm. beyond it. No tear was found (fig. 9 *A*).

An operation was deemed advisable on the following grounds: (1) the history of trauma to the head and left eye; (2) the presence of recent chorioretinal changes associated with a flat, grayish elevation of the retina; (3) the presence of "dusty" opacities in the vitreous, which are found in retinal detachment and not in myopia; (4) the frequently recurring scintillations in the sector of the field corresponding to the affected retina; (5) the inadvisability of conservative treatment by prolonged rest in bed, on account of the age of the patient and the associated pulmonary, myocardial and renal disorders.

One was faced with the problem of coagulating small areas in the choroid without injuring the retina. To attain this end it was necessary to control carefully (*a*) the depth to which the electrode penetrates the sclera (not more than 1 mm.), (*b*) the duration of its application and (*c*) the intensity of the current, which should not exceed the necessary minimum.

With these points in mind the operation was performed as follows: A 3 point electrode of the Šafář type was carefully introduced in the 11 o'clock meridian and 15 mm. behind the limbus, an attempt being made not to exceed a depth of 1 mm. Similar applications were made along a line parallel with the limbus as far as the 9:30 o'clock meridian. Several single punctures were applied in front of this line so as to connect its extremities with the region of the ora serrata. Only one puncture was followed by escape of some fluid. No attempt was made to remove any more fluid (fig. 9 *B*).

Ophthalmoscopic examination after the operation showed only two small grayish areas of coagulation of the choroid. Apparently overcautious timidity on my part prevented some of the punctures from penetrating down to the choroid.

Examination on April 5, 1934 showed vision in the right eye with —0.25 sph. —1.75 cyl., axis 70 to be 20/20; in the left with —5.50 sph., 20/15. The field showed 20 degrees of contraction in the lower temporal sector. Ophthalmoscopy revealed in the upper nasal sector of the fundus, very near the ora serrata, three small whitish-grayish patches—faint diathermic scars in the choroid.

No summary, comments or conclusions are necessary. The reader who has had experiences similar to those reported in this paper may derive some benefit by comparing his own cases with those reported here and may form his own conclusions. Those who are just beginning to familiarize themselves with this method may profit from reading the reports of my failures.

The diathermy apparatus used was placed at the disposal of the staff of the Herman Knapp Memorial Eye Hospital by its maker, Liebel-Flarsheim of Cincinnati. After considerable experimentation a machine has been developed which furnishes three types of current: for cutting, coagulation, and mixed for retinal detachment (R-D). The current is a combination of cutting and coagulation currents, each in proper proportion so as to give the desired effect.

ABSTRACT OF DISCUSSION

DR. ARNOLD KNAPP, New York: Dr. Schoenberg, in his excellent paper, has discussed the reasons why in some cases after operation the retina becomes reattached and in others fails to do so. I can best add to the discussion of this subject by reviewing the causes of failure in my own cases. There have been forty cases. For purposes of description, these cases can be grouped under the following headings: ora serrata tears, five; holes, twenty-seven; no holes discoverable, five; aphakia, two; perforating injury, one. Of these, four showed improvement, seven no influence, and twenty-nine reattachment.

In case 1 an enormous tear extended from the 1:30 to the 4:30 o'clock meridian. An attempt was made to fasten the proximal margin. Unfortunately, at the last puncture a hemorrhage occurred, which recurred after two days. When the media became clear, the retina was found to be detached and in folds. The case was inoperable, as the size of the tear was too great to attempt shutting it off by operation.

In case 2 the sclera was so thin that it was blue. On perforation there was a large escape of fluid vitreous with collapse of the eyeball, so that a further attempt at coagulation seemed unwise. The eye recovered with unchanged vision and field, and the detachment was still present. Another attempt may be made later on, but whatever is done will have to be accomplished at the first attempt. Possibly the Gonin operation with cautery would be the best method.

In case 3 the area of the hole was shut off by coagulation. The detachment returned, but, as no lesion could be recognized, no further operation was done on account of the patient's age (72 years).

In case 4 there was a large detachment with the hole far back. It was difficult to apply the electrodes far enough back because of a prominent orbital ridge. Partial reattachment occurred.

In cases 5 and 6 the detachment accompanied choroiditis. There were no holes or suspicious lesions discoverable in the retina. Electrocoagulation succeeded in improving the field and partly replacing the retina; vision has improved, but a shallow detachment is still present.

Case 7 was one of total detachment with a large hole in the retina very far back, which had been operated on. The attempt to close this opening did not succeed, and the detachment is unchanged.

Case 8 presented a total detachment with no visible hole. Several operations had been attempted elsewhere. A line of coagulations was made in the lower half of the eyeball without any effect in replacing the retina.

In cases 9 and 10 the patients were both aphakic. The retina hung down from above in both. There were no holes to be seen, but there was a preretinal band in one case and retinal folds in the second. Electrocoagulation was followed with adhesion of the retina above, but a month later a detachment formed below. Another coagulation below did not replace the retina. No further operation will be undertaken, as the condition is regarded as a disturbance of the vitreous.

Case 11 is interesting, as the detachment followed the successful removal of an intra-ocular foreign body by the scleral route. There were faint vitreous bands between the two wounds of the sclera, and the retina underneath this region was detached. This area was coagulated, and the retina is being held in place, though it is still partly detached.

An important point in the successful treatment of retinal detachment is the recognition of the hole or retinal lesion. Experience has shown that closure of the hole is essential to success, and a great deal of time must be given to this

search. If there are opacities in the vitreous or in the lens, a very strong light will be helpful. As it is difficult to gage the position of the hole in a prominently detached retina it may sometimes be advisable to tap the detachment and then examine the patient again.

As the detachment follows the laws of gravity, the causative site may not always be found at the point of greatest detachment. It is a good working rule to concentrate on the upper outer quadrant, where the holes so frequently develop.

It is self-evident that the more peripheric the opening, the easier the access is. Also, there is a limit to the size of hole that can be closed by this operation.

The detached retina must be capable of unfolding, so that it can become flattened out and reattached.

The condition of the vitreous is also most important. A moderate escape of subretinal fluid at the site of the electrocoagulation is favorable, but the appearance of firm vitreous at the puncture sites is not desirable, as it indicates a new opening into the retina. If the vitreous is fluid from extreme degeneration, the eyeball collapses and further operation is difficult.

There are a number of instruments and types of apparatus in use which can give good service. It would be an improvement if one could vary the amount of coagulating power in the current employed according to the conditions found in each case.

Ophthalmologists are learning to recognize the cases of detachment of the retina in which a cure can be expected, and the results which are being obtained in this condition with electrocoagulation are truly remarkable. It is no longer legitimate to lose time by nonoperative methods of treatment. If the case is suitable for operation, the sooner it is done, the better will be the results.

Dr. Harry S. Gradle, Chicago: The question of surgical treatment of detachment of the retina is still an open proposition. Advocates of various types of operation have published statistics of cases that number from a few to several hundred, and no two operators show any great degree of unanimity. As a result, one can merely grope in the dark and try everything, regardless of strict surgical indications. It is still impossible to offer a definite prognosis before operation, and it will probably be some time before any prognostic conclusions can be reached.

I wish to offer a few of my observations based on a limited number of cases. These cases date from the first part of 1929 to August 1933, so the shortest period of observation of any case has been in excess of ten months. I have performed fifty-eight operations on thirty-nine patients: in twenty-seven cases, one operation; in seven cases, two operations; in three cases, three operations, and in two cases, four operations. About half of these were Weve operations, and the other half were equally divided between the Guist and the Gonin operation. In twelve patients an anatomic reattachment persisted.

Allow me to speak of the contraindications to operation: The detachments of pregnancy should never be attacked surgically. The large funnel-shaped detachments of high myopia offer a hopeless outlook. The flat detachments that have existed over a longer period of time usually are beyond hope. The detachments occurring in aphakic eyes offer a bad prognosis, although operation is not contraindicated. Detachments in association with anterior uveitis are apt to be uninfluenced by operation. Detachments in association with tuberculosis of the retina and choroid do not yield satisfactorily to operation.

Prognostically, what detachments can be considered hopeful from a surgical standpoint? First come the detachments of the lower degrees of myopia, either with or without a tear. However, these degenerate fairly rapidly, so that operation should be performed within the first three months.

Next come those that one thinks may be due to blunt trauma. Here, too, time is an element and the sooner the operation is performed, the better are the chances for reattachment. The cases associated with exudative processes in the retina and choroid (excepting such as are tuberculous) stand a fair chance of success by operation, unless the basic lesion is located near the posterior pole of the eye. Time does not seem to play the enormous rôle here that it does in some of the other forms. One case of this type occurred in a man 39 years of age. The detachment in the right eye was of one year's duration, and that in the left eye of three years' duration. A Weve operation was performed on the right eye, with a complete anatomic reattachment and vision of better than 4/10. But interestingly enough, during the three weeks' rest in bed subsequent to operation, the left retina that had been detached for three years became reattached in all except one quadrant, but without useful vision. Now, I wonder whether my operation or the enforced rest in bed was the cause of the splendid result.

Regardless of these suggestions, I still believe that one should operate on every retinal detachment that offers any possible chance of success. To operate merely on hopeful ones for the purpose of bolstering one's batting average may be a good thing for the individual patient and for the operator's record, but will not help the profession to determine the strict surgical indications for operative interference in detachment of the retina.

Dr. Dohrmann K. Pischel, San Francisco: I should like to ask Dr. Schoenberg what strength of current in milliamperes he is using and for what length of time? I believe the dosage in milliamperes as well as the time is important. Granted that one is using clean electrodes and that the field is dry, fairly uniform choroidal changes can be caused by equal dosages of current. I believe that while too strong a current may cause excessive damage, one is more prone to err on the side of using too weak a current. Therefore I usually employ a current of about 80 ma. for from four to five seconds. With this current the pin must be quickly pushed through the sclera and the current allowed to continue to flow for the required time. The pin must be in contact with the sclera before the current is turned on.

Another point in Dr. Schoenberg's paper that I wish to emphasize is the distribution of the pins. In his earlier cases he kept them well away from the region of the ora serrata. In his later cases he brought each end of the line of pins, or treated points, close to the ora. This I believe accounts for the higher percentage of successes in his more recent cases.

This type of operation, which seeks to demarcate or wall off the affected area of the retina from the remainder of the fundus, depends for success on one important feature. As Lindner, who developed the theoretical basis of this operation, points out, the operation must create a solid line of choroiditis from the ora, around the affected area and back to the ora again. Coming close to the ora may not be sufficient, as a small bridge of free retina will allow the fluid to pass under it and lift off the rest of the retina, vitiating any attempt at healing. Therefore it is necessary to put the pins in close together, evenly spaced, and up to the ora serrata.

In explaining the possible cause for some of his failures Dr. Schoenberg mentioned a vitreous adherent to the retina. This is of utmost importance. If the retina is being pulled away by a shrinking vitreous, no operation can seal or wall off the hole, as the retina will not come back to come in contact with the exudative choroiditis. Therefore I feel a case has a bad prognosis if one sees that the

detached retina does not float freely, but merely quivers when the eye is suddenly moved (for this shows that the solid vitreous still holds the retina).

If at all possible, one should wait for the vitreous to liquefy, thus releasing the retina and allowing it to float back into place after an operation. During the period of waiting, if stenopeic spectacles are worn, little increase in the size of the detachment will occur, unless the vitreous still pulls on the retina. In fact the detachment may become smaller, as an instance will illustrate. This was a large bullous detachment temporal and above. The patient, a 60 year old man, was suffering from a cold and cough. While waiting for this to clear up, he wore stenopeic spectacles but remained ambulatory. Nevertheless the field and vision improved. Finally operation brought the case to a successful conclusion.

Dr. Gradle has pointed out the indications for this operation. In agreeing with him, I should like to point out that in cases of detachment of the retina one is dealing with a hopeless disease if treated conservatively. The only practical hope lies in surgical intervention. If one does nothing, blindness results; if one operates, one may save sight.

With this feeling I have not refused to operate on any patient with a detachment who wished me to do so, no matter how gloomy the outlook. The results are most interesting. Following operations on twenty-six patients in private practice and at the Stanford clinic, ten complete cures have resulted. The most interesting features are brought out by dividing the cases into those with a favorable and those with an unfavorable prognosis. There were eleven with a favorable outlook, and these can be dismissed with the statement that seven resulted in cures. There were sixteen cases with an unfavorable prognosis, including such conditions as eyes previously unsuccessfully operated on by another method, aphakic eyes after discission, old iridocyclitic eye, with old detachments in the fellow eye, cases of eighteen months' or longer duration, keratoconus, perforating injuries and retinitis proliferans. Yet out of sixteen patients with such conditions, three were cured and one was so improved that he again saw his children, although a remnant of the detachment remained. Two of these bad conditions were in only eyes.

Therefore, I feel that one should not hesitate to try to help these patients, no matter how unfavorable the outlook.

Dr. L. Peter, Philadelphia: During the last eight months I have operated in twenty-one unselected cases of retinal detachment by diathermy, using the Walker unit and needles. I failed in one instance to secure reattachment of the retina. This was due to faulty technic and probably to poor surgical judgment. In the remaining nineteen cases, reattachment was obtained, and the visual fields showed varying degrees of improvement from slight enlargement to complete restoration. In three instances of long standing, macular vision failed to improve. In one of these cases, the tear was in the neighborhood of the macula. Most of the cases in which good central vision was obtained were of less than six weeks' duration, so that the time element is important so far as central vision is concerned. However, the location of the tear in the neighborhood of the macula or considerable edema in the macula are factors which interfere with good visual results. In my experience, reattachment can be secured in most cases, but good and useful vision is largely predicated on the duration of the detachment and the area in which it occurs.

Etiology is a second factor of importance in securing good results. Detachments due to certain forms of vascular disease, as well as those due to a shrinking of the vitreous body and traction bands, do not yield as readily to surgical intervention as those which arise from trauma. I am, however, in accord with the

essayists in believing that in addition to the etiology and the duration of the detachment, accuracy in locating the tear, if it is demonstrable, and detail in the operative technic are most important in obtaining reattachment and good central vision in most cases which are of less than a year's duration. The more recent the detachment, the better the results are, other things being favorable.

The operation is not difficult. It is within the reach of the average operator who has sufficient material to acquire finished technic. Results will be poor if care is not exercised in accurately locating the tear when it is visible, and in the minute study of the fundus when tears are not demonstrable. Results will be equally poor if good surgical judgment and refined surgical technic are lacking.

Diathermy offers a new and unparalleled future for the cause of retinal detachment if the operation is done with precision and the case is carefully studied before the operation is undertaken.

Dr. Harvey E. Thorpe, Pittsburgh: The sine qua non of successful healing of retinal detachment is still careful localization and sealing of the retinal hole. A sketch of the fundus is invaluable. If the tear is not found, an idea about its location may be gleaned from the history of the first involved field, namely, the area which was first obscured or first showed light flashes.

Ophthalmoscopic examination in a reclined position after the patient has been in bed two days and even after aspirating a minim of subretinal fluid is very helpful, as suggested by Dr. Schoenberg and Dr. Knapp. More than one hole may be present and thus be discovered. This is often responsible for recurrence of detachment.

The corneal contact glass has been helpful to me in the study of the retinal periphery, especially in aphakia. I use a 12 mm. scleral curve and 7 mm. corneal curve contact glass. In one case of aphakia with detachment and undilatable pupil the glass was helpful in finding a peripheral tear.

For the diathermic operation, to repeat what others have stressed, a dry globe and sufficient current for penetration is essential. A wet globe and insufficient current cause tissue shrinkage and scleral shortening.

Scleral pins 1.8 mm. long are used for the perforation of sclera and choroid. I use 1.2 mm. long pins near the ora to electrocoagulate the sclera and choroid beneath it. My pins are similar to those shown today by Dr. Pischel.

Thorough familiarity with the topographic anatomy of the eyeball is essential. After-treatment should be strict. The patient must rest in bed three or four weeks, lying on the side corresponding to the detachment. The foot of the bed is elevated if the tear is above. The head of the bed is elevated if the retinal hole is below.

Much can be added to the mental comfort of the patient by permitting the bedside use of a small radio. Patients are extremely grateful for this.

Lindner's "hole" spectacles are of considerable help and should be used for from five to six months after permanent removal of the bandage. After two months they are left off for two hours daily. A guide is necessary on the street during this period. A patient of mine wearing "hole" spectacles stumbled, fell and struck his head. Fortunately his retina did not redetach.

I have observed insufficiency of convergence following use of the Lindner spectacles.

Dr. Oscar Wilkinson, Washington, D. C.: There is a valuable method of coagulation for the relief of detached retina that has not been mentioned. I agree that the use of the Walker apparatus is the best method of the type in which perforation is employed. I am in hearty accord with the use of that instru-

ment, but the transscleral coagulation method of Larsson, I think, is particularly indicated in a certain type of case. It is, in my mind, especially indicated in that type of case in which the sclera is very thin and blue—the type of case in which Dr. Knapp reports the loss of the fluid from simple coagulation, which prevents further work on the eye. The second type of case in which it is indicated is that of flat detachment near the macular region. I believe that with proper study and careful use of the transscleral diathermy we have a valuable aid in cases of this character.

Dr. Mark J. Schoenberg, New York: I agree with Dr. Pischel, that one ought to be more merciful and operate in those cases which appear hopeless, rather than reject a case in which improvement may be obtained.

In my series the cases were not selected. I took every case that presented itself, both because I wanted to give the patient a chance, and because I was curious to see what would happen. Dr. Pischel asks what amperage I use. A study of the literature on the subject of electrosurgery, discussions with engineers and my own experience lead me to believe that the ammeter is not a reliable guide as to the amount of current to be used at any given moment. The resistance of the tissues is not always the same; neither are two adjoining areas of the outer surface of the eyeball equally resistant to the current. One has to learn by experience and by trying out the effect of various intensities of current, by using it on the eyes of animals, liver, potatoes, etc. One has to learn the workings of the apparatus one is using. The apparatus I use (Liebel-Flarsheim) has a dial indicating the "power-control." By numerous trials it has been found that for the 1 point electrode it is necessary to set the indicator at 30; for the 2 point electrode at from 40 to 50; for the 3 point electrode at 60. It is safer to begin by using a weaker current and to increase it gradually up to the point where the electrode is driven in with ease.

As far as the type of current is concerned, I have not yet reached a definite conclusion. I am sure that it will take years before it will be known definitely which is the best type of current to use.

With all respect to Dr. Walker's machine, I am not in love with it, because it is too rigid; it gives me only one type of current. I prefer a machine that can furnish a coagulating current when one wants it, a cutting current or a mixed current (coagulating and cutting) in proper proportions.

Dr. Thorpe's suggestion is extremely interesting. I think that the idea should be followed up. The use of the contact glass in order to allow one to see a portion of the fundus nearer to the ora serrata, especially in cases of aphakia, is a useful suggestion.

Dr. Wilkinson's idea is extremely interesting. I always had the idea in the back of my mind that there are cases in which the Larsson method is applicable. The only trouble with this method as originally published was that the electrode Larsson used was entirely too large, and for this reason the reactions were very extensive. If one used very small electrodes, 0.5 mm. in diameter, for example, or even 0.25 mm., properly applied and held for a sufficient length of time, one could treat lesions in the macular area and cause a minimum amount of damage.

Dr. Pischel has asked how long I keep the electrode in the eye. I take it out immediately. A too prolonged application of the current coagulates the retina also, and coagulation of the retina alone is sufficient to increase the amount of detachment.

CHRONIC UVEITIS

BACTERIOLOGIC AND IMMUNOLOGIC CONSIDERATIONS

ALBERT L. BROWN, M.D.
CINCINNATI

The current conception of the etiology of chronic inflammation of the uveal tract includes chiefly the theory of focal infection and its ramifications. The specific organisms of syphilis [1] and tuberculosis [2] have been isolated from the eye in cases of disease of the uveal tract. Likewise, organisms have been cultured in cases of metastatic intra-ocular inflammation.[3] This suggests the possibility of the dissemination of organisms in so-called nonspecific uveitis. Proponents of this view argue that there is a circulation from a focus of the actual organisms, organisms with a predilection or specificity for uveal tissue, or of the toxin of organisms to the eye.

An attempt has been made to analyze this view and to test its various aspects experimentally. When an organism enters the eye, it must meet existing conditions portrayed by the aqueous and vitreous, intra-ocular tissue and the intra-ocular portion of the blood stream. If there is a circulation of organisms from a focus in cases of chronic uveitis, a fair proportion of the patients should yield positive blood cultures. Furthermore, if an organism displays elective localization for a tissue sufficiently to cause constant recurrences of inflammation of the uveal tract, its power should remain the same or become enhanced by association with uveal tissue and should not be attenuated for this specific tissue. It is also reasonable to assume that if organisms are present in the eye and associated with these attacks, uveal tissue from such eyes should yield at least a fair proportion of positive cultures. This briefly summarizes the method of approaching the problem.

From the Children's Hospital Research Foundation.

This investigation was aided by a grant from the Schmidlapp Foundation.

Read before the Section on Ophthalmology at the Eighty-Fifth Annual Session of the American Medical Association, Cleveland, June 13, 1934.

1. Collins, E. T., and Mayou, M. S.: Pathology and Bacteriology of the Eye, ed. 2, Philadelphia, P. Blakiston's Son & Co., 1925, p. 557.

2. Meller, J.: Ztschr. f. Augenh. **76**:407, 1932; **77**:1, 1932.

3. Herrenschwand: Die pathogenen Mikroorganismen des Auges, Berlin, Urban & Schwarzenberg, 1927, p. 167.

BACTERICIDAL POWER OF THE AQUEOUS AND VITREOUS HUMORS

A study of the bactericidal power of the intra-ocular fluids seemed a logical approach to the question of intra-ocular growth of organisms. Organisms actually carried into the eye are certain to be profoundly affected by any bactericidal activity exerted by the fluids. Organisms brought to the interior of the eye by the blood surely come in contact with these fluids and, if at all susceptible to their influence, must be destroyed, attenuated or encouraged. Cronstedt [4] reported his work and reviewed reports of other authors on the bactericidal properties of the vitreous. His reports of the literature indicated that such properties were found to be essentially negative. Cronstedt himself reported the presence of a mild thermolabile bacteriolytic substance which could be activated by blood serum. In the main, however, he found the vitreous to be a fair culture medium for many organisms.

To observe the rôle the fluid contents of the ocular chambers play in the growth of intra-ocular organisms, the following experiments were carried out.

Fifty eyes of freshly killed pigs were used for the determination of the bactericidal power of intra-ocular fluids. The material was used within one-half hour after the pigs were killed. The aqueous and vitreous of ten eyes were used to note the properties of the specimens individually, and the aqueous from the remaining forty was pooled to give a quantity sufficient for cultural purposes. The anterior segment of each eye was passed through a gas flame and the aqueous drawn off by puncturing the anterior chamber with a sterile 29 gage needle. The cornea was then removed, the iris pulled out with sterile forceps and the vitreous expressed into sterile containers.

The first consideration was to note the bactericidal power of the fluids on cultures of organisms already established. Blood agar plates inoculated with single cultures of Staphylococcus aureus, Bacillus subtilis and a streptococcus known to produce iritis when injected into the carotid artery were lined into four squares. Aqueous from individual pig's eyes was dropped on one square of five plates and on two squares of five other plates. Samples of vitreous from the individual eyes were treated similarly. After incubation for five days at 37 C. there was no relative difference between the growths on any of the squares.

The pooled aqueous and some of the remaining vitreous were mixed with mediums to note any inhibiting power on the growth of organisms. Beef infusion broth, which is a good general culture medium, was mixed with equal quantities of aqueous. Tubes containing 5 cc. of aqueous humor and 5 cc. of broth were inoculated with cultures of the organisms used in the aforementioned experiments. There was no apparent difference in the growth of organisms in the mixture as compared to that in the control tubes containing 10 cc. of broth alone. Association of the streptococcus with aqueous and vitreous did not attenuate the ability of a growth to produce iritis in rabbits by injection into the carotid artery. In fact, a colony of streptococcus transferred to vitreous humor grew quite well and produced iritis when injected into the carotid artery of a rabbit.

4. Cronstedt, L.: Svenska läk.-sällsk. handl. **49**:157, 1923; abstr., Zentralbl. f. d. ges. Ophth. **12**:11, 1924.

Aqueous and vitreous were obtained in a similar manner from fourteen enucleated human eyes. Four eyes were the sites of chronic uveitis (*vide infra*) and ten did not show intra-ocular inflammation. The latter included four intra-ocular tumors, four cases of absolute glaucoma and two irreparably damaged eyes. No case of perforating injury was used, so as not to introduce the element of exogenous infection. The sarcomatous eyes yielded 1 cc. of aqueous each, as did one eye with uveitis. No aqueous was obtained from the other eyes because of obliterated anterior chambers. Each specimen of aqueous and vitreous was used as a unit in order to note any differences in the individual properties of each eye. Each unit was placed on a section of culture medium in a plate containing a growth of Staph. aureus, B. subtilis and the streptococcus used to produce experimental iritis. None of the growths so treated were influenced by aqueous or vitreous. The observations show that the aqueous or vitreous have little if any bactericidal power. The blood serum and the intra-ocular fluids must be considered as separate, and their bactericidal activity divided by the blood vessel walls. If an organism is brought within the eye and escapes the blood stream, its growth depends on its ability to survive in the tissue which may harbor it, for interference from normal intra-ocular fluids is negligible. This contention was further supported by the next series of experiments.

ACUTE IRITIS FOLLOWING THE IMPLANTATION OF ORGANISMS IN THE EYE

In a previous communication [5] a method of producing acute iritis without trauma to the eyes was described.

A suspension of organisms injected into the carotid artery of a rabbit was usually effective if the organism was sufficiently virulent. This was simply a method of fairly direct transmission without injury to the eye. An attempt was made to study the ability of certain organisms so injected to grow inside the eye in the presence of various intra-ocular fluids. The left eye of an anesthetized rabbit was irrigated with a mild antiseptic; the conjunctiva was incised near the outer canthus and the sclera exposed in the upper outer portion. The sclera was cut through with a cataract knife 6 mm. beyond the limbus, an incision about 6 mm. long being made roughly parallel to the limbus. The vitreous was scooped out through this incision with a small spoon, the eye at the same time being perfused with physiologic solution of sodium chloride to maintain the approximate tonus of the globe and to evacuate the remaining vitreous and aqueous. The perfusion was continued for two minutes, so that any remaining blood or vitreous would be negligible. The conjunctiva was then replaced over the scleral wound with the lower end loose, so that a sterile needle could be inserted through the sclera to perfuse later if the bleeding did not stop. This animal was given an injection of the strain of streptococcus in suspension in the left carotid artery. When the bleeding seemed to have abated the scleral wound was sutured fairly tightly and the conjunctival flap placed over the wound and sutured. The needle of the syringe with physiologic solution of sodium chloride was once more introduced and the eye filled to an approximately normal tonus. The animal was watched for a time to note any seepage of physiologic solution of sodium chloride from the incision, but the edges of the wound were apparently water-tight and

5. Brown, A. L., and Dummer, C.: The Experimental Production of Iritis, Arch. Ophth. **2**:573 (Nov.) 1929.

held the eye in a fair state of tonus. Twelve hours later there was a massive exudate in the anterior chamber, and a culture of this exudate composed of fibrin and pus cells revealed the injected organisms. The procedure was repeated on three other animals with the same results.

The same experiment was performed on a fresh rabbit, using blood serum from the same animal instead of saline solution. The serum was obtained from 15 cc. of the rabbit's own blood after clotting. An incision measuring only 3 mm. was made, for only a small amount of vitreous was removed to allow the introduction of from 2 to 3 cc. of blood serum. When the eye contained blood serum on both sides of the vessel walls, that is, blood in vessels and blood serum in the vitreous chamber, iritis occurred more tardily and less violently. No ocular inflammation occurred in the first rabbit, but this may have been simply coincidental. In a second rabbit a mild iritis developed within twenty hours. A purulent exudate developed from which the organism was recovered. A third animal was quite resistant to the organism, a slight iritic irritation developing twelve hours after the injection. This subsided and disappeared. The eye gradually collapsed and became shrunken, but the animal lived for three weeks and then died from a generalized dissemination of the injected organism. This organism was recovered from various organs at autopsy. A fourth animal had no ocular symptoms. The eye became shrunken in twenty-four hours, and the animal died from generalized dissemination ten days later. These procedures were repeated with whole blood in four other rabbits. The results resembled those obtained when blood serum was used.

Implantation with various mediums gave the following results:

Aqueous and vitreous undisturbed:

1. Active iritis in six hours; panophthalmitis; destruction of the eye in thirty-six hours.
2. Ciliary injection in seven hours; hypopyon in twelve hours; panophthalmitis in twenty-four hours.
3. Ciliary injection in eight hours; pupillary exudate in twelve hours; panophthalmitis in twenty-four hours.
4. Active iritis in ten hours; hypopyon in twenty-four hours; panophthalmitis in thirty-six hours.

Physiologic solution of sodium chloride:

5. Ciliary injection in seven hours; panophthalmitis in twenty-four hours.
6. Pupillary exudate in ten hours; panophthalmitis in twenty-four hours.
7. Hypopyon in twelve hours; panophthalmitis in thirty-six hours.
8. Hypopyon in twelve hours; panophthalmitis in twenty-four hours.

Blood serum, from 2 to 3 cc.:

9. No evidence of intra-ocular infection in twenty-four hours; eye has good tonus; eye quiet in forty-eight hours, but becoming soft; no infection in fifty-six hours, eye very soft; intra-ocular fluid aspirated, cultured on blood agar; no growth in forty-eight hours.
10. Slight ciliary injection in twenty hours; slight hypopyon in thirty-six hours; pus aspirated, cultured and injected organism recovered; marked ciliary injection in forty-eight hours; eye very soft; hypopyon slightly greater in sixty hours; eye almost collapsed; animal died two months later; eye shrunken.

11. Slight ciliary injection in twelve hours; tonus good; eye slightly irritated in twenty-four hours; ciliary injection much less; eye softer in thirty-six hours, but quiet; animal died in three weeks; autopsy revealed multiple abscesses throughout the body; injected organisms recovered from the liver and spleen; contents of eye sterile.
12. Eye soft in twelve hours; no inflammatory signs; eye collapsed in twenty-four hours, but white; animal died in ten days; organisms recovered from the liver; contents of eye sterile.

Whole blood, from 2 to 3 cc.:

13. Marked ciliary irritation in twenty-four hours; eye becoming soft; hypopyon in thirty-six hours; pus aspirated from anterior chamber and injected organism recovered; hypopyon absorbed in forty-eight hours; eye very soft; hypopyon reappeared in sixty hours; panophthalmitis in seventy-two hours.
14. Eye quiet in twenty-four hours; good tonus; no ocular infection apparent at any time; tonus of the eye remained in good condition for six days; animal died in two weeks; organism recovered from small abscesses in the liver and spleen; no organisms recovered from the eye.

TABLE 1.—*Comparison of Results Obtained by Injecting the Organism Into the Carotid Artery and Into Other Parts of the Body*

	Local Symptoms	No Local Symptoms	Total Number
Injected into carotid artery	20 a	5 b	
Not injected into carotid artery	2 c	103 d	
			130 N

15. No sign of ocular infection at any time; animal died in ten days; organism recovered from the spleen and liver; no organisms recovered from the eye.
16. Eye quiet throughout the entire course; tonus of the eye remained good for three days, gradually began to shrink; became collapsed in one week; animal killed; no organism recovered at autopsy; contents of the eye sterile.

The results point to the probable protection of intra-ocular structures by antibodies in the blood serum. The antibody content in the blood may be raised by various means, but even in the presence of a high concentration in the blood, the concentration of such antibodies in the aqueous is notoriously low.[6] Thus it seems that not only are the intra-ocular tissues unprotected by a low antibody content but that there is also a lack of bactericidal power in the intra-ocular fluids.

From the data shown in table 1 the question "Are local symptoms produced more frequently by injecting the organism into the carotid than by introducing it into a remote part of the body?" can be answered affirmatively.

6. Leber, A.: Arch. f. Ophth. **64**:413, 1906. Kodama, R.: Ocular Reactions in Anaphylaxis, J. Infect. Dis. **28**:48 (Jan.) 1921.

There is a distortion apparent in the distribution shown in table 1: $X^2 = 87.59$, which indicates in the theory of probability that the chances are more than 400,000,000,000 to 1 that a distortion as great as or greater than the one exhibited by distribution into four cells would arise by the operation of chance alone and without the intervention of any casual factor.

SPECIFICITY OF ORGANISMS FOR UVEAL TISSUE

The theory of Rosenow and his followers regarding the elective localization of organisms in a tissue is very attractive. Although their views are not accepted in all quarters, I believe that this phase deserves consideration. So far as the eye is concerned, Rosenow [7] has reported the occasional production of infection of the uveal tract by the intravenous injection of organisms. In one series, he found one case in nineteen to be produced in that manner. Recently he reported the recovery of streptococci from the teeth of persons with sites of active inflammation. The intravenous injections of streptococci into rabbits produced a high percentage of localization in analogous structures affected in the subjects yielding the organisms. Zanettin [8] reported the enhancement of uveal affinity of a strain of staphylococci by growing the organisms in the presence of uveal tissue. Experiments in this connection were reported in 1929; [9] in these I found the opposite to be true. The organisms recovered from eyes infected by injection into the carotid artery after reculture produced milder attacks after each subsequent culture and reinjection and finally failed entirely. Uveal tissue grown with these organisms seemed to attenuate the virulence for the uveal tract, and after the third or fourth passage by injection into the carotid artery through uveal tissue did not cause iritis at all but caused death by general dissemination. These results were confirmed for three strains of streptococci and two strains of staphylococci. In a more recent discussion of their paper, Rosenow and Nickel [10] supported this contention by their own observations.

In my experiments, to obviate the possibility that passage through several cultures might attenuate the streptococcus, a separate growth was recultured simultaneously with each recovery of the organism from an infected eye. The recultured organism was injected into the carotid of a new rabbit every time the recovered organism was injected and was found to have an unaltered ability to reproduce the iritis after at least five recultures.

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7. Rosenow, E. C.: J. Infect. Dis. **17**:403, 1915.
8. Zanettin, G.: Ann. di ottal. e clin. ocul. **61**:20 (Jan.) 1933.
9. Brown, A. L.: Am. J. Ophth. **15**:19 (Jan.) 1932.
10. Rosenow, E. C., and Nickel, A. C.: Am. J. Ophth. **15**:1 (Jan.) 1932.

Positive reactions after association with uveal tissue were as follows:

1. Organism injected into carotid.....20 in 25
2. Organism injected intravenously..... 1 in 25
3. Organism recovered from the eye, recultured and reinjected in the carotid artery becomes attenuated and fails after the fourth injection; positive reactions obtained after the fourth injection..... 2 in 25
4. Organism grown on medium as control for test 3 is reinjected in carotid each time material in test 3 is reinjected from reculture .....20 in 25
5. Organism grown with uveal tissue in medium and injected into carotid artery.....21 in 25

The fortitudinous lodgment of organisms in the eye in cases of recurrent uveitis seems to be an untenable view. It is suggested that instead of the specificity of the organisms, the preparation of the tissue by sensitization more nearly explained clinical phenomena.

TABLE 2.—*Comparative Virulence of Organism for the Uveal Tract*

	Local Symptoms	No Local Symptoms	Total Number
Culture not associated with specific body tissue.....	20 a	5 b	
Culture associated with specific body tissue.....	2 c	23 d	
			50 N

From the data shown in table 2 the question "Is the virulence of an organism for the uveal tract enhanced by association with uveal tissue?" may be answered negatively.

There is a distortion also apparent in table 2: $X^2 = 26.30$, which indicates in the theory of probability that the chances are about 1,800,000 to 1 that a distortion as great as or greater than the one exhibited by the distribution into four cells would arise by chance alone and without the intervention of any causal factor.

IMPLANTATION OF INFECTED FOCI

The theory of focal infection assumes the existence of an infected site which discharges the organisms or their products into the circulation. In the case of recurrent uveitis, if such organisms were transmitted to the uveal tract, they would necessarily set up a local infection. Such an instance is followed by the formation of pus and great manifestations of inflammation. This is an unremitting process which usually goes on to panophthalmitis. Experimentally, when organisms injected into the carotid artery localize in the uveal tract, there occurs an inflammation which never abates and continues to panophthalmitis with destruction of the eye. This is not at all a clinical picture of recurrent iritis which presents little or no formation of pus, often clears with

local treatment and recurs at irregular intervals without destruction or oft-times even impairment to the eye. It seems rather fanciful to consider each of these attacks as due to the presence of a specific organism which has a special affinity for uveal tissue, lies dormant after an attack and is brought directly to the eye again for an indefinite number of recurrences.

This view may be investigated from various angles including that of focal infection and elective localization. Injection of organisms into the carotid artery is too direct a route to prove anything but the fact that the organisms can produce an infection if they enter the eye. The intravenous introduction of organisms starts with the unusual premise in that a bacteremia is at once introduced and the concentration of organisms must be mechanically altered to introduce just enough organisms to produce a local infection but not overwhelm the animal. Blood cultures of patients with uveitis are usually negative, unless the patient has a bacteremia and the eye happens to be one site of dissemination.

To more nearly conform to the present conception of a focus of infection, I used a strain of streptococci known to produce iritis when injected into the carotid artery. This was injected into the gums of rabbits until abscesses were formed. These were then allowed to develop and kept active by reinjection, but in no case was iritis produced from the dissemination from such foci. All the animals lived for two months or more, and three were found to have dissemination into organs at autopsy. Agar blocks containing a fairly heavy growth of the same organisms were planted in the abdominal muscles of ten rabbits. The fate of these animals depended entirely on the individual reaction. One animal showed no effects in a month, and autopsy revealed no pathologic changes except a small scar at the site of implantation. Another rabbit died in two weeks from peritoneal involvement. Some animals were unaffected. In no case was the eye affected. Small infected agar blocks were implanted beneath the buccal mucous membrane in ten other animals. In one animal an acute iritis followed by panophthalmitis developed in the left eye. Both knees of ten more rabbits were given injections and kept active, and the ocular and general manifestations were noted. The eyes of all these animals remained unaffected. Thus in an average of one rabbit in eighty an infection from an implanted remote focus developed within the eye.

A different situation prevailed, however, when the eye was sensitized to the toxin from the same strain of streptococci. The toxic filtrate of a broth culture was injected into the anterior chamber of one eye in another series of rabbits. A summary of typical reactions is given in table 3. In a large proportion of infected animals the sensitized eyes responded with varying degrees of inflammation of the uveal tract.

TABLE 3.—*Condensed Table Showing Typical Reactions of Rabbits Following Implantation with Infected Foci of Streptococci*

Site of Focus	Sensitized by Toxin in Anterior Chamber	Time of Reaction	Reaction in Eye	Fate of Animal and Autopsy
Gums and dental roots	.....	.....	.....	Died in 3 mouths; no dissemination
Gums and dental roots	.....	.....	.....	Living after 1 year
Agar block in abdominal muscle	.....	.....	.....	Animal killed after 3 months; local scar
Agar block in abdominal muscle	.....	.....	.....	Died in 5 days; peritoneal infection; no organism in eye
Agar block in buccal mucous membrane	.....	.....	.....	Abscess of inner cheek; died in 3 weeks; general dissemination
Injections into both knees; kept active; joints swelled	.....	.....	.....	Animal died in 2 weeks; general dissemination; no organisms in eye
Injections into both knees; kept active; joints swelled	.....	.....	.....	Animal died in 10 days; general dissemination; no organisms in eye
Agar block in buccal mucosa membrane	Both filtrate of injected organisms before implantation	12 hours 36 hours	Acute iritis; then quiescence Acute iritis with exudate	Died in 4 weeks; small healed scar in cheek; no organisms recovered from eye or other organs
Agar block in buccal mucous membrane	Filtrate of injected organism 24 hours after implantation	6 hours 24 hours 5 days	Acute iritis, mild Severe iritis lasting 40 hours Mild iritis with vitreous deposits; iritis quieted, but deposits remained	Killed in 4 weeks; scar in cheek; no organisms recovered
Agar block in buccal mucous membrane	3 days before implantation	8 hours after implantation	Acute iritis, fairly severe and quieted in 5 hours; recurred in 36 hours; eye enucleated and cultured; culture negative	Animal died in 10 days; organisms recovered from liver and spleen; none in eye
Injections into both knees; kept active; joints swelled	Filtrate 24 hours before implantation	6 hours after implantation	Acute iritis with vitreous deposits; eye quiet in 5 hours; no recurrence	Animal died in 3 weeks; general dissemination; no organisms recovered
Injections into both knees; kept active; joints swelled	Filtrate 24 hours after implantation	10 hours after filtrate	Mild iritis; quiet in 5 hours; recurred twice within next 4 days	Animal killed in 5 days; eye removed during height of inflammation; no organisms in culture
Gums and dental roots; kept active	Filtrate 24 hours before implantation	8 hours after implantation	Iritis; quiet in 6 hours; recurred in 2 days and lasted 2 days; recurred in 2 weeks and lasted 3 days	Animal died in 3 months; no organisms recovered at autopsy
Gums and dental roots; kept active	Filtrate 36 hours after implantation	6 hours after filtrate	Iritis; quiet in 8 hours; no recurrence	Animal died in 6 months; general dissemination; no organism in eye
Gums and roots; kept active	Filtrate 36 hours before implantation	.....	.....	Animal died in 10 months; general dissemination; no organisms in eye
Agar block in abdominal muscle	Filtrate 3 days before implantation	2 days	Mild iritis; quiet in 24 hours; no recurrence	Animal died in 6 months; no organisms found
Agar block in abdominal muscle	Filtrate 3 days after implantation	.....	.....	Animal died in 8 months; no organisms found
Agar block in abdominal muscle	Filtrate 6 days before implantation	24 hours	Severe iritis; animal inactive; rapid respiration	Animal died in 48 hours; peritoneal involvement; organisms recovered from peritoneal cavity, none from eye

These reactions were comparable to those found in other experiments on sensitization recorded previously. They also simulated clinical recurrent inflammation of the uveal tract by the absence of pus and the disposition to clear without impairment and to recur.

Positive reactions after implantation of foci were as follows:

1. Organism injected intravenously..... 1 in 25
2. Organism injected intravenously after ocular sensitization .....98 in 100
3. Organism implanted as focus..... 1 in 80
4. Organism implanted as focus after sensitization.....13 in 15
5. Organism implanted as focus before sensitization.....12 in 15

From the data shown in table 4 the question "Does an organism injected or introduced into a remote part of the body activate the eye more severely after local sensitization?" may be answered affirmatively.

TABLE 4.—*Comparative Virulence of Organism for Sensitized and for Nonsensitized Animals*

	Local Symptoms	No Local Symptoms	Total Number
Sensitized animals	123 a	7 b	
Nonsensitized animals	2 c	103 d	
			235 N

From Pearson's [11] formula of probability,

$$X^2 = \frac{(ad - bc)^2 N}{(a + b)(c + d)(a + c)(b + d)}$$

there is a distortion immediately apparent in the table, i. e., not an equal distribution in all cells: $X^2 = 200.52$, which indicates in the theory of probability that the chances are more than 400,000,000 to 1 that a distortion as great or greater than the one exhibited by the distribution into four cells would arise by chance alone and without the intervention of any causal factor.

BLOOD CULTURES OF PATIENTS WITH IRITIS AND UVEITIS

Many observers have attempted to recover an organism from the blood of patients with intra-ocular inflammation, but there is no uniformity in the observations. In 1925, Clawson reported a greater than average number of positive blood cultures in cases of acute rheumatic fever. He ascribed his results to the fact that he took 50 cc. of blood, allowed it to clot and then cultured the clot. He favors the idea held in many quarters that there are sufficient antibodies even in normal

11. Pearson's formula, in Pearl, R.: Medical Biometry and Statistics, ed. 2, Philadelphia, W. B. Saunders Company, append. 3, table B.

blood serum to interfere with bacterial growth. He placed the clot in flasks of 250 cc. of dextrose (0.2 per cent) beef infusion broth of p_H 7.6 at 37 C. His positive cultures appeared in from five to ten days and occasionally took a month to grow. Traut,[12] using Clawson's [13] technic, reported five positive blood cultures of streptococci from patients with acute iritis. Two of these five patients had arthritis, and one, syphilis. The fact that these three patients had suggestive etiologic symptoms put them in a class of specific rather than nonspecific iritis. Although the observations are of interest for this type of case, they have no bearing on the nonspecific type dealt with here.

In order to meet all possible objections to my observations on blood culture, I asked three serologists what the main causes of failure to find organisms in blood are. Their answers pointed chiefly to an insufficient quantity of blood and to the time allowed for incubation. They all stated that any serum antibodies present in 20 cc. of blood placed in more than 50 cc. of broth infusion were too diluted to affect bacterial growth. In spite of this assurance, it was thought wise to obviate the objections of those requiring culture of a clot. Thirty cubic centimeters of 50 cc. of blood obtained from each patient was allowed to clot and the clot cultured in dextrose (0.2 per cent) beef infusion broth of p_H 7.6 at 37 C. for fifteen days. The other 20 cc. of whole blood was placed immediately in rich dextrose-beef heart bouillon.

The blood of eighty-one patients with some form of intra-ocular inflammation was cultured as described. All the samples were taken while the eyes were actively inflamed. There were forty cases of iritis, fifteen of which represented the first attack in one eye and twenty-five, the second or a subsequent attack in one or both eyes. The other forty represented inflammation of the posterior segment. There was one case of metastatic infection from a septic abortion, which resulted in panophthalmitis before death. Syphilis, tuberculosis, trauma and arthritis were ruled out as carefully as possible on the assumption that they represented rather specific evidence of profound local or general changes.

There were two instances of positive blood cultures in the eighty-one specimens examined. One was a culture of streptococci obtained from the blood of a woman with a bilateral panophthalmitis following a septic abortion. Pus aspirated from the anterior chamber of the one eye contained the streptococcus found in the blood culture. This patient died of a general septicopyemia. The other positive culture was a streptococcus obtained from a man with pyelitis. This patient also had a chronic uveitis which abated in three weeks and then recurred with

12. Traut, E. F.: Am. J. Ophth. **17**:106 (Feb.) 1934.

13. Clawson, B. J.: Etiology of Acute Rheumatic Fever, J. Infect. Dis. **36**: 444 (May) 1925.

showers of vitreous deposits. The pyelitis was unusally resistant, and each attack seemed a precursor of an exacerbation of the uveitis which occurred from five to eight days after each renal attack. Three blood cultures were made during the height of an attack of pyelitis, and three were made during an exacerbation of the uveitis after the one positive blood culture had been obtained. Thus, the last six cultures were negative. An attempt was made to determine whether the number of organisms was great during an exacerbation of uveitis since one of the positive cultures was obtained during an attack of pyelitis. It is possible that the organisms were present in greater numbers just before an attack of uveitis, but this was not borne out in any of the other instances in which cultures were made before, during, and after ocular recurrences. Thus, of eighty-one cases of active intra-ocular inflammation, only two showed positive blood cultures, and these two had demonstrable infection of marked proportions in sites other than the eye.

BACTERIOLOGIC EXAMINATION OF AQUEOUS AND UVEAL TISSUE FROM CASES OF CHRONIC UVEITIS AND RECURRENT IRIDOCYCLITIS IN MAN

If the presence of organisms in the uveal tract is concerned with the production of chronic uveitis, the culture of tissue should be positive in a fair proportion of instances. Various observers have found organisms in the aqueous of eyes with acute metastatic iritis, as I found in the case of septic abortion mentioned.

The presence of organisms within the eye in nonspecific uveitis became a pivotal point. The determination of this question was represented in the culture of thirty-seven specimens of aqueous obtained from twenty-seven cases of recurrent iridocyclitis and uveitis, five sections of irides and the uveal tracts of five enucleated eyes. During the height of an exacerbation, the aqueous was aspirated from the anterior chamber with a 28 gage hypodermic needle after the eye had been anesthetized by instillation of 2 per cent butyn and prepared aseptically. The needle was passed into the anterior chamber, and 0.2 cc. of aqueous was slowly aspirated. The aqueous was at once run on a culture plate. In no case was the eye harmed by the withdrawal of aqueous. On the contrary, the eye became less painful, appeared to be generally improved, and in several instances the breaking of synechia was apparently facilitated. The five conditions requiring iridectomy for secondary glaucoma developed during the height of inflammation as a result of unbreakable massive synechia. The other five eyes with old uveitis were enucleated because they were blind and painful and were removed during an acute exacerbation. The five enucleated eyes were passed through a gas flame, and the cornea of each eye was cut across as in a cataract section. The entire cornea was removed by cutting the section with sterile scissors.

The sclera was then cut through equatorially and the vitreous humor removed. A sagittal section was saved for microscopic examination. The uveal tract was stripped off, and the iris was detached from the rest of the tract and cultured separately. Thus, the choroid and ciliary body with some of the retina were cultured as a unit and the iris as another. The aqueous and the sections of the iris from the iridectomized eyes were likewise cultured separately. This was accomplished by passing a 28 gage hypodermic needle attached to a 2 cc. syringe over the blade of a Graefe knife after the puncture and counterpuncture and aspirating before the small section was completed with the knife. An assistant held up the corneal flap with a small hook, and the iridectomy was performed within the eye and the iris section lifted out without allowing it to touch the conjunctiva.

The various units including the uveal tract from the enucleated eyes and the aqueous and sections of the iris from the iridectomized eyes were each divided into three parts. Each unit of tissue was finely divided by gentle maceration in distilled water. Each part was placed in separate culture tubes, each containing a different medium. One part was placed in a tube of Rosenow's veal brain broth, another on a partial oxygen blood agar slant and a third on an anaerobic blood agar slant. Every culture but one was found to be entirely sterile after incubation at 37 C. for five weeks. In all the cultures of one eye with old chronic uveitis profuse growths of staphylococci developed in two days. This was obviously a contamination, for the eye had been affected for eight years with frequent recurrences and had become blind. Enucleation was requested by the patient because of three painful attacks in one month. Preoperative examination showed an atrophic iris bound to the lens with massive exudate. The eye was soft, and there was no perception of light. There was no gross or microscopic evidence of pus within the eye.

The sections preserved for pathologic examination presented evidence of chronic uveitis in the main. No noteworthy changes were observed.

COMMENT

Since the report of observations concerning ocular sensitization,[9] I have been persuaded that intra-ocular inflammation is largely produced by the production of uveal sensitization. Syphilis, tuberculosis and trauma are excepted for the present, but there are many indications that these three factors may be concerned with ocular sensitization as well. Friedenwald [14] produced ocular tuberculosis in rabbits by sensitization which more nearly approached the clinical type than that produced by the direct injection of organisms. Woods [15] has developed Elschnig's

14. Friedenwald, J.: Allergy and Immunity in Ocular Tuberculosis, J. Arch. Ophth. **9**:165 (Feb.) 1933.

15. Woods, A., and Little, M. F.: Tr. Sect. Ophth., A. M. A. 1932, p. 297.

theory of uveal sensitization in sympathetic uveitis and believes that this is a major part of the basis of this disease. There is likewise evidence of the allergic qualities of Spirochaeta pallida. From a clinical standpoint, chronic uveitis does not resemble inflammation produced by the direct invasion of organisms. It is true that the former recurs with cell exudation, but in many instances this is microscopic. Such an eye may become the site of recurrences with little impairment from the separate attacks, the damage being caused by the sum of the repetitions. The latter shows clearly the result of the invading organisms by rapid formation of pus usually leading to panophthalmitis. When cultured the intra-ocular pus in such an eye usually yields abundant organisms. On the other hand, numerous observations show that the cultures of intra-ocular contents or even pus from a hypopyon iritis are sterile. Certainly if organisms were present they would produce typical signs of invasion in the great majority of cases of so-called "nonspecific" uveitis. All observations point to the ability of an organism which can survive the blood stream to grow rapidly inside the eye. Having gained entrance to the uvea, the organism is not only protected from the antibodies in the blood serum owing to the inability of such antibodies to traverse the blood vessel walls in any great quantity, but it is actually encouraged by the low bactericidal power of the aqueous and vitreous, which in certain instances seem to act as a favorable culture medium.

The specificity of certain organisms for the uveal tract assumes the circulation of those organisms to the uvea for each recurrence and their ability to incite a subacute chronic inflammatory process without formation of pus which remits and recurs at intervals. In my experiments each eye invaded by organisms showed great formation of pus which never abated and ended in panophthalmitis. The eyes which were previously sensitized to the toxin of such organisms were activated repeatedly by the intravenous injection of the same organisms without formation of pus, with comparatively slight exudation and a recovery which was marked only by the amount of unabsorbed exudate. Moreover, the organisms recovered from infected uveal tracts became attenuated after repeated passage through animals and finally lost their ability to reinfect other eyes on reinjection in the blood stream. In short, the uveal tract was prepared for the reception of the products of the organism instead of the organism being prepared for invasion. Finally, the bacteriologic examination of the aqueous, sections of iris tissue and, in four cases, the entire uveal tract in cases of known recurrent iritis and chronic uveitis is cited as evidence that these reactions occurred without the presence of organisms in the eye. In the absence of other evidence to the contrary it is suggested that such cases are due to the sensitization of the uveal tract and activated repeatedly by a specific antigen.

SUMMARY

1. The present conception of the etiology of chronic inflammation of the uveal tract is considered from bacteriologic and immunologic standpoints.

2. The bactericidal power of the aqueous and vitreous was found to be negligible.

3. The normal intra-ocular contents, or physiologic solution of sodium chloride replacing these contents, do not interfere with the intra-ocular growth of the streptococcus used. Autogenous blood serum or whole blood within the eye definitely inhibits the growth of this organism intra-ocularly.

4. Foci of infection were implanted in parts remote from the eye, and ocular inflammation developed in one animal in eighty.

When the eye was sensitized by a toxic filtrate of the organism the remote foci activated the eye in twenty-five of thirty instances. The same organisms injected intravenously after such sensitization activated it in ninety-eight of one hundred instances.

5. A strain of streptococcus, known to produce iritis when lodged in the eye by injection into the carotid artery, affected the eye in one of twenty-five instances when injected intravenously.

6. Organisms grown within the eye or with uveal tissue in vitro became attenuated for the eye after repeated passages. The original strain carried simultaneously was unaffected.

7. Blood cultures of eighty-one patients with iritis and uveitis were negative, except in two cases. These two cases showed gross generalized inflammations.

8. The bacteriologic examination of aqueous and uveal tissue from cases of chronic uveitis and recurrent iridocyclitis in man gave negative results except in one case which was considered a contamination.

311 Doctors' Building.

DISCUSSION

DR. WILLIAM ZENTMAYER, Philadelphia: In the beginning it was believed that organisms from remote foci of infection enter the blood stream and produce a bacteremia; yet it was impossible to cultivate the same organisms from the primary and secondary foci, and, as Dr. Woods states, it is difficult to understand why a discrete, remote secondary focus should occur. Rosenow advanced the theory of selective affinity of organisms, especially of the streptococcus, but such predilection has not been generally accepted. Kolmer suggested other possibilities to explain the secondary uveal localization of the organism. All this evidently has been inconclusive and difficult to harmonize with clinical facts.

The difficulty of establishing a causative relation between nonspecific and what the author designates as chronic uveitis is attested by the fact that the proofs by which this relationship is established for specific organisms are absent here and some theoretical possibility has to be introduced. A possible explanation is found

in the proved participation of the eye in bacterial hypersensitivity produced by inoculation of animals with nonhemolytic streptococci.

The essayist has undertaken the task of putting to experimental test the early views.

In the group of experiments in which physiologic solution of sodium chloride or blood serum or whole blood is substituted for the removed vitreous, one must admire the resourcefulness of the experimenter, but the thought occurs whether legitimate conclusions can be drawn from experiments in which fluids foreign to the vitreous cavity are employed in a much traumatized eye.

That the essayist's unusual opportunity of culturing the blood of eighty-one patients with intra-ocular inflammations, among whom were forty with iritis, resulted in only two positive blood cultures, and these in patients with demonstrable infections of marked proportion in sites other than the eye, seems to point strongly against the theory that the condition is due to blood stream infection.

Kolmer, at the first meeting of the Ophthalmological Research Society, pointed out the importance of preserving iris tissue removed in cases of recurrent iritis for bacteriologic study. Because of the occurrence of secondary glaucoma in twenty-seven cases of recurrent iridocyclitis and uveitis, Dr. Brown had the exceptional opportunity of acting on this suggestion. The fact that in all but one case the culture was negative indicates the absence of organisms in the removed tissue.

The author is led to the conclusion that sensitization more nearly explains the clinical manifestations; it must be understood that this conclusion is reached more by exclusion than by direct proof.

One need but read the work of Friedenwald, Woods and others to realize that there is not one missing link but many, and that neither the clinical facts nor the laboratory findings nor the investigators' results have placed the problem outside the realm of controversy.

There are still many authors who frankly disavow an etiologic relationship between nonspecific focal infection and uveal inflammation.

Dr. Alan C. Woods, Baltimore: Dr. Brown raises two fundamental questions: 1. Is iritis associated with focal infection always due to bacterial metastases to the affected eye? 2. Cannot iritis or uveitis, associated with remote foci of infection, be due to sensitization and intoxication of the uveal tract by the bacteria or their products from the remote focus?

In discussing the first question, Dr. Brown's arguments are as follows, if I may be permitted to rearrange slightly his order of presentation:

1. The picture of experimental iritis due to bacterial infection differs from the picture of uveal inflammation associated with foci of infection as observed clinically. The accuracy of this observation is apparent, but the artificial form of inoculation used in the production of experimental iritis and the massive dose of bacteria used in the injection make it impossible to draw any definite deduction from this observation.

2. Experiments on rabbits show that artificially produced foci of infection rarely, if ever, produce metastatic intra-ocular infections.

3. A study on the in vitro bactericidal action of the ocular fluids shows that there is little, if any, bactericidal action in the aqueous and vitreous. This observation is confirmed in similar experiments performed by Dr. Burky and Dr. Freeman.

4. An experiment in which the vitreous was completely removed from the eyes of rabbits and the eyes were then filled with saline solution on the one hand, and

with blood serum on the other hand, indicates that there is a definite bactericidal action in the blood serum which is not shown by physiologic solution of sodium chloride. This experiment does not seem particularly pertinent or convincing, and Dr. Brown wisely refrains from drawing any specific conclusions from the experiment.

5. Dr. Brown presents an interesting experiment on the selective affinity of bacteria for uveal tissue. This experiment confirms his earlier experiments reported in 1929 and indicates that the growth of an organism in the uveal tissue does not enhance its affinity for such tissue. In fact, the contrary is true. The virulence of the organism for uveal tissue is apparently diminished by its association with the specific tissue. This result does not conform with the results reported by other investigators, as is noted by Dr. Brown, and it is rather difficult to offer any reason for this observation.

6. Dr. Brown found that cultures of the blood of patients with acute ocular disease associated with foci of infection are consistently negative; this fact, he believes, argues against the probability of the iritis being due to a bacterial metastasis through the blood stream. This evidence, however, is only weakly negative. The bacteremia responsible for the fortuitous lodgment of organisms in the eye and producing few, if any, other symptoms, must of necessity be a transient bacteremia quickly overwhelmed by the normal resistance of the patient or by the bactericidal action of the blood. Detection of such a bacteremia by blood culture would be a chance happening. Furthermore, it is reasonable to assume that such a transient bacteremia would precede the iritis rather than be present during the acute stages of the ocular inflammation.

7. The final point against recurrent iritis being due to actual bacterial invasion of the eye is the inability to recover organisms by culture of the aqueous, or even of the uveal tissue of the inflamed eyes. Dr. Brown presents the evidence of thirty-seven such cultures, all uniformly negative except for one case of obvious contamination. To a somewhat less extent we have performed the same experiment in the Wilmer Ophthalmological Institute. The aqueous was withdrawn from ten eyes with acute iritis. This aqueous was cultured, and the remainder was injected directly into the eyes of rabbits. In all ten instances the cultures were negative, but in one rabbit a uveitis which terminated in rupture of the sclera developed in the eye into which aqueous from a case of acute iritis had been injected. Certainly one must admit that all evidence is against organisms being present, at least in any number, in the eyes of patients with acute iritis.

While individually not conclusive, each of these points builds up consistently Dr. Brown's argument that iritis associated with a focus of infection should not be considered as being due invariably to bacterial metastases. These experiments suggest that some other factors enter into the causation of acute uveal disturbances secondary to remote foci of infection.

In the presentation of his second question Dr. Brown reports experiments which attempt to explain recurrent iritis associated with foci of infection on the grounds of sensitization and intoxication of the ocular tissues to the bacteria or bacterial products from the focus of infection. This is far from being a new idea. As early as 1902 Menzer offered a somewhat similar suggestion to explain the occurrence of certain forms of recurrent arthritis associated with remote foci of infection. Kolmer and others have repeatedly stressed the point that the theory of bacterial metastases to the affected eye does not fit in with the clinical picture frequently observed in recurrent iritis, and they have suggested that allergy to bacteria or their products may be responsible for the ocular inflammation.

Dr. Brown's experiment on the production of iritis through the sensitization and intoxication of the eye may be divided into two parts. In the first part the sensitization of the eye is obtained through the implantation of an infected agar focus, and intoxication is obtained through the intra-ocular injection of the filtrate of cultures of streptococci. Again, this experiment is not new but is, with a few technical differences, a repetition of the classic experiments of Swift and Derick, Hitchcock, Schultz and their co-workers. These authors found that a generalized sensitivity to the products of streptococci can be produced in animals only by special procedures. The intravenous injection of streptococci into rabbits does not produce any special sensitivity of the animal, but sensitivity can be obtained through the intracutaneous injection of small doses of organism or by the use of agar implants infected with streptococci. These authors have demonstrated that the superficial tissues of the eye—the cornea and the conjunctiva—participate in this generalized sensitivity. An ophthalmic reaction can be obtained by instilling either killed or living cultures of streptococci in the conjunctival sac after a preliminary scarification of the cornea. Their experiments indicate that the cutaneous hypersensitivity becomes apparent about the fifth day and that the ophthalmic hypersensitivity is well developed by the thirteenth day. Dr. Brown used four rabbits in which he first made a buccal agar implant infected with a streptococcus. Within from twenty-four hours to three days after this implant an injection of the filtrate of cultures of the same streptococcus was made into the anterior chamber. An iritis developed in three of the four rabbits. In one rabbit this was a recurrent phenomenon. If one accepts this experiment as a definite allergic reaction it indicates that the sensitivity of the ocular tissues develops within twenty-four hours after the implanting of an agar focus. The development of such a sensitivity in so short a time is very surprising. One cannot help but wonder whether the iritis observed in the eyes of the rabbits was not a reaction to a foreign protein such as might be observed in a normal eye after inoculation of a culture filtrate into the anterior chamber. Unfortunately, Dr. Brown presents no controls illustrating the action of a streptococcus filtrate on the eyes of normal animals.

In the second part of this experiment Dr. Brown reversed the procedure used by Swift and Derick. The rabbit's eyes were sensitized by an injection of the filtrate from the streptococcus culture into the anterior chamber, and then in periods varying from twenty-four hours to six days after this inoculation an infected agar focus was implanted in the rabbits. In six of the seven rabbits thus treated an iritis developed from six to forty-eight hours after the agar implant. If one accepts this as an allergic reaction it indicates that the sensitivity of the eye to the products of the streptococcus follows certainly within twenty-four hours after the direct exposure of the ocular tissues to the bacterial products. While so quick a development of sensitivity is striking, it is not so surprising as the development of an ocular sensitivity in a like period of time after an infected agar implant. In this instance the direct exposure of the tissues to the bacterial products tends to produce a sensitivity much more quickly than would the absorption of such bacterial products from an agar focus. The development of the iritis in from six to forty-eight hours after the the agar implant is interesting. It is to be regretted that Dr. Brown did not allow a longer interval to elapse before the agar implant was made for the possibility that the ocular reaction was a delayed reaction to the injection of foreign protein in the anterior chamber or was due to the direct action of the toxin on the ocular tissues cannot be entirely ruled out. The experiment would be more convincing if the eye had been allowed to undergo a period of quiescence before being exposed to the absorption of the bacterial products of the agar focus of infection.

These experiments, however, carry the work of Swift and Derick and their co-workers further. If future control experiments can rule out the possibility of the ocular reaction being due either to a foreign protein or to the action of the toxin on the eye this experiment indicates that the bacterial products diffusing from a chronic focus of infection can produce inflammatory intra-ocular reactions in sensitized ocular tissues.

Dr. Brown is to be congratulated on his approach to the problem. I agree thoroughly with the reasoning outlined in his study to the effect that hypersensitivity of the eye to bacteria and subsequent intoxication by absorption from foci of infection is the logical explanation of many forms of recurrent iritis observed clinically. He has ably presented the arguments in favor of this hypothesis. His experiments on the production of iritis through the sensitization and intoxication of the ocular tissues are the proper point of attack on the problem.

Dr. Jonas Friedenwald, Baltimore: This is an extremely important piece of work, and the progress that Dr. Brown has already made casts a great deal of new light on the obscure problem of the relation of intra-ocular inflammations to focal infection. Because of the importance of this contribution it seems to me that it should be examined as critically as possible, and so without any intention of unfriendliness, I shall submit to you a few points which appear important.

In the first place, the theses which Dr. Brown is trying to prove are separable into two distinct problems. Dr. Brown wishes to discover (1) whether allergic sensitization of the eye is an important element in the production of inflammatory lesions, and (2) whether the exacerbation of the previously sensitized eye is due to a bacterial metastasis or to some soluble products of the bacteria reaching the eye through the blood stream.

These two problems appear to be entirely separate. If allergy is the important element in the consideration, it may or may not be true that the secondary outbreak of the inflammation is due to bacterial metastasis or to some soluble toxin or bacterial product arriving in the sensitized organ.

I do not agree with Dr. Brown's interpretation of two points. The perfusion experiments which he has reported, in which the perfusing fluid was infected with bacteria and the time of growth of the organism in the eye measured, do not, I think, prove anything in regard to the eye in vivo. An eye perfused with saline solution or with aqueous is not alive, and the bactericidal activities of the living uveal tract are certainly not reproduced under such circumstances. It is not clear, therefore, whether the inhibition of growth of bacteria resulting when the eye was perfused with blood serum or with whole blood was due to bactericidal properties of the blood serum or whether it was due to the better survival of the ocular tissues.

Dr. Brown has quoted my work on ocular tuberculosis, and I wish to say that the analogy to his experiments is not strictly true. The reproduction of a type of ocular tuberculosis in animals, similar to that which occurs in man, was achieved in the experiments which I performed by a preliminary sensitization of the whole animal followed by the injection of a virulent strain of the tubercle bacilli. So far as the experiments with tuberculosis are to be compared with those of Dr. Brown, they should be taken to indicate that at least in one injection the presence of the bacillus in the eye is essential to the production of the disease even after sensitization.

I also want to emphasize the point raised by Dr. Woods as to the importance of the time relationship in Dr. Brown's experiments. If sensitization of the ocular tissues is the important element necessary for the development of the disease, then

that sensitization should certainly go through some sort of a cycle, and a careful study of the character of the ocular reactions in relation to the time of subsequent reinfection should throw a great deal of light on the problem.

DR. CONRAD BERENS, New York: My associates and I have been unable to obtain positive cultures from aqueous fluids, the iris or intra-ocular tissues. It would be interesting to know how Dr. Brown made his studies of ocular tissues.

Following Burbank's suggestion of incubating the whole joint in studying rheumatic joints, we incubated the whole eyeball in two cases of chronic uveitis for five days with negative results.

Another important point is that several infections may be active in causing a certain disease of the eye. Positive reactions suggesting syphilis or tuberculosis do not necessarily indicate that the ocular disease is caused by these infections. Many patients may also have several foci of infection which may or may not be factors in the etiology of the ocular lesion. We have studied the serobacteriologic reactions in patients with certain ocular diseases in an attempt to determine the presence of toxic organisms. We found a high percentage of toxic organisms in many patients, particularly in those with a recurrent type of chronic uveitis.

A preliminary report of this work was presented to the International Congress on Ophthalmology (Berens, C.; Connolly, P. T., and Chapman, G. H.: La infección focal en las enfermedades de los ojos, *Tr. Internat. Ophth. Cong.* **1**:247, 1933). We studied the agglutination and complement-fixation reactions, the hemolysis and coagulase tests of staphylococci and an adaptation of the carbonate method of Burbank to the study of the toxicity of streptococci. These tests were compared with inoculation of animals and with the intradermal reaction with separate organisms.

It is possible that cultures made from eyeballs which have been incubated for a longer period may reveal organisms not discovered in the shorter period of incubation, but I believe that in the majority of cases the ocular lesions are toxic or allergic rather than infectious in origin.

We also studied elective localization by the inoculation of individual strains selected by serobacteriologic tests. Rosenow used fresh but impure cultures and pointed out that if there is any delay in injecting the cultures or if time is taken to select the organisms, the organisms lose elective power. We were unable to obtain localization in the eyes of rabbits with pure cultures of organisms which apparently were pathogenic and toxic for rabbits as judged by the rapidity with which the animals died from the intravenous inoculation. This finding further confirms Dr. Brown's work.

DR. ALBERT LOUIS BROWN, Cincinnati: I shall try to answer as many questions as possible.

Dr. Zentmayer stated that the experiment with intra-ocular contents did not necessarily show anything beside the fact that whole blood or blood serum is probably more bactericidal than physiologic solution of sodium chloride. That is exactly what I attempted to show in this experiment. It was performed in vivo for the sake of completeness. Dr. Woods mentioned the same point.

Dr. Woods stated that the work is not original. This study is not presented as an original piece of work. It is an attempt to summarize the present conception of the etiology of chronic uveitis, which is of course very confusing, is built on no experimental work and is based on very little fact. So far as I have been able to discover, no one has attacked the problem of focal infection in direct comparison with the allergic theory. Furthermore, I found nothing in the literature concerning the culture of intra-ocular contents in sufficient quantity to arrive at an

expression of opinion. One is well aware that thirty years ago animal eyes were subjected to injections of foreign protein and activated by intravenous injection.

Dr. Woods mentioned another point which is fundamental; namely, whether the injection of toxic substance alone was sufficient to cause the manifestations noted. The ocular injections produced irritation which often subsided in three or four hours and occasionally persisted for twenty-four or thirty-six hours. Such eyes never became active again unless they were activated by the reintroduction of specific antigen into the body. This could be done five or six times in from twenty-four hours to fourteen days after the original ocular injection. Each activation became weaker than the preceding one until no reaction could be obtained.

Dr. Friedenwald mentioned that his work in tuberculosis was not analogous to mine. No analogy was implied. I specifically excluded syphilis, tuberculosis, trauma and arthritis as representing profound constitutional changes and, therefore, altering the conditions found in nonspecific uveitis. I only wished to call attention to the fact that these factors have also been noted to be associated with allergic manifestations in the eye.

Dr. Berens asked whether the eyes were incubated before culture. Since I was not interested in anything but the uveal tract, I made no pretense of culturing the whole intra-ocular contents.

Clinical Notes

BUPHTHALMOS IN IDENTICAL TWINS

FREDERICK A. KIEHLE, M.D., AND CLINTON PUGMIRE, M.D., PORTLAND, ORE.

We are reporting a case of unilateral buphthalmos occurring in opposite eyes in identical twins. The case is interesting because in each twin only one eye was involved, on opposite sides in the two children, and because of the dissimilarity of the degree of involvement in the two patients.

REPORT OF A CASE

History.—These children (S. C and J. C.) were brought into the ophthalmologic clinic of the University of Oregon with the complaint of enlargement of one eye of each child. At the time of entrance they

Buphthalmos in identical twins.

were 6 years old. The mother stated that when they were 3 months old she noticed that one eye of each of the boys started to become enlarged, since which time there had been a steady enlargement of the affected eyes. There was no family history either of defects of this kind or of other developmental defects.

Data for S. C.—The left eye was involved; the right eye was essentially normal.

Examination: Vision in the right eye was 20/20, and in the left, 10/100, which was improved slightly with a minus correction. The tension was normal in the right eye and 65 mm. (McLean) in the left. The fundus in the right eye was normal; in the left there was a deep cup in the nerve head which extended to the margin of the disk. Roentgen examination showed slight enlargement of the left bony orbit. On microscopic examination no pathologic changes were noted in the right eye. In the left there were numerous ruptures of Descemet's membrane; the lens was clear, and the iris was somewhat atrophied. Ocular movements were normal.

From the Ophthalmic Clinic, University of Oregon Medical School.

Treatment: An Elliot trephination was performed. A good filtrating scar was obtained, and an uneventful recovery was made.

Progress: Since that time (six months) the boy has been observed every two weeks, and the tension has always been within normal limits (McLean). We consider the operation successful.

Data for J. C.—The right eye was involved; the left eye was essentially normal. The involvement was somewhat more marked in this boy than in his brother. There was a rather indefinite history of trauma to the eye with intra-ocular hemorrhage following.

Examination: The eye was large; the cornea was hazy, and the iris had a muddy appearance. A large, whitish mass of lens material could be seen floating at the lower border of the iris. Vision in the left eye was 20/20; in the right there was no light perception. The tension in the left eye was normal, and in the right, 75 mm. (McLean). In the left eye the fundus was normal; in the right it could not be seen owing to the extreme haziness of the cornea and vitreous. Roentgen examination showed a definite enlargement of the bony orbit of the right eye. Microscopically there were seen numerous breaks in Descemet's membrane. The cornea was hazy and showed numerous posterior deposits. The lens was seen as a whitish mass completely detached except at the lower pole. It appeared to be partly calcified.

Treatment: The right eye was enucleated, and a glass ball was placed in the socket.

Findings in the Enucleated Eye: The eye measured: anteroposteriorly, 31 mm.; transversely, 27.5 mm., and supero-inferiorly, 27 mm. The cornea measured: transversely, 14.5 mm., and supero-inferiorly, 14.8 mm. The cornea curvature was: highest, 6 mm. above the limbus, and lowest, 4 mm.

Ophthalmologic Review
EDITED BY DR. FRANCIS HEED ADLER

POWER OF OPHTHALMIC LENSES

HARRY EGGERS, M.D.
NEW YORK

The aim of this review is to indicate in a simple manner how the power of an ophthalmic lens varies with its contour, thickness and distance from the eye.

The reader perhaps will recall from his knowledge of the properties of lenses in air that, among other things, a lens possesses two principal planes (A_1H_1 and A_2H_2 in the biconvex lens depicted schematically in figure 1), which are perpendicular to the axis and so disposed that incident rays which are directed toward any point (such as A_1 in figure 1) in one principal plane will be directed on emergence as though they came from a point (A_2) in the second plane which is on the same side of, and at the same distance from, the principal axis as the first point. The points where the principal planes meet the principal axis are called principal points (H_1 and H_2 in figure 1). Rays which are directed toward one of them before refraction emerge as though coming from the second principal point and in a line parallel to the direction at incidence. Another interesting characteristic of the principal planes is that they are located so that, irrespective of the curvatures of the surface, the principal focus (F_1) on one side is just as far from its principal point (H_1) as the other focus is from the second principal point (H_2). The distance from either principal focus to the corresponding principal point is known as the focal length of a lens.

PRINCIPAL POINT REFRACTION

By the equivalent power of a lens is meant the reciprocal of its focal length, the latter being expressed in meters. This is sometimes used as the measure of refractive power. The shorter the focal length the greater is the equivalent power and the stronger the lens. A lens with a focal length of 1 meter has an equivalent power of 1 diopter. This method of measuring the refractive power of a lens is not always satisfactory for ophthalmic purposes, because the position of the principal points is inconstant, varying with both the thickness and the shape of a lens, while, on the other hand, all lenses, regardless of their form or thickness, are worn at the same distance from the eyes—theoretically, 15.7 mm. from the cornea, but actually somewhat closer, depending on

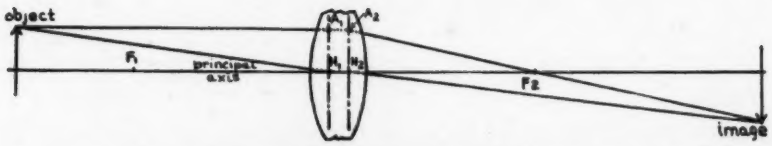

Fig. 1.—Diagram of a biconvex lens, showing the two principal planes, A_1H_1 and A_2H_2. In this figure and the following figures, F_1 indicates the anterior principal focus, and F_2 the posterior principal focus.

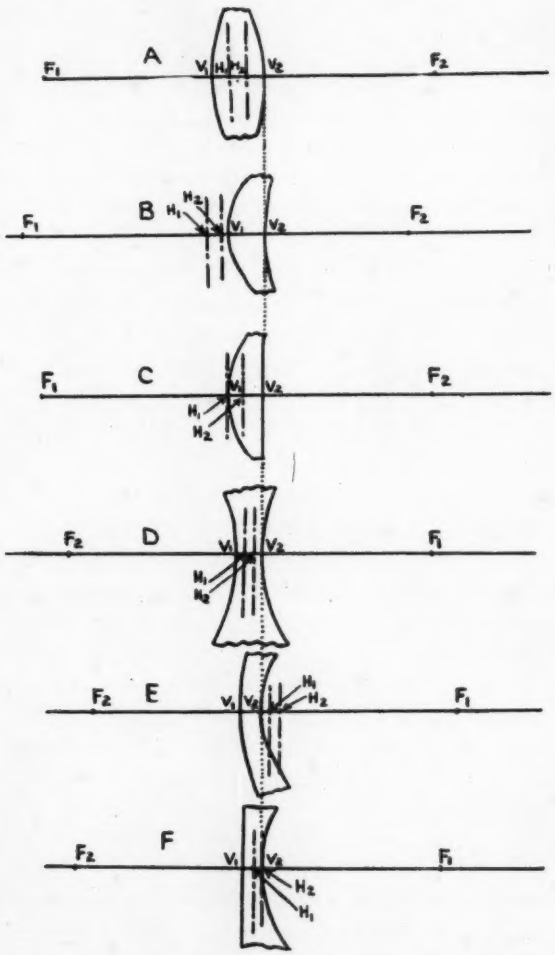

Fig. 2.—Schematic representation of six lenses, all with the same numerical equivalent power and placed so that the rear poles or vertices are in line with each other. For all the drawings, since the equivalent power is the same, the distances F_1H_1 and F_2H_2 (the focal length) are constant and equal. *A* shows a biconvex lens; *B*, a converging meniscus (meniscus), in which the principal points are located outside the lens on the convex side; *C*, a planoconvex lens, in which the first principal point is at the vertex of the curved surface and the second is in the interior of the lens; *D*, a biconcave lens; *E*, a diverging meniscus (contrameniscus), in which the principal points are outside the lens on the concave side, and *F*, a planoconcave lens. For all the concave lenses, the anterior principal foci are located on the same side as the posterior foci for the convex lenses and vice versa.

the length of the eyelashes. Figure 2 shows in an exaggerated way how the positions of the principal points vary with the shape of the lens.

VERTEX REFRACTION

In figure 3, two converging lenses of the same focal length are represented schematically. One is a biconvex lens, and the other a meniscus. If these were labeled according to the old system of equivalent power or principal point refraction, both would be marked identically, say x diopters. Although the focal length of each is 1/x meters, they do not produce the same effect on an eye at the same distance from the rear vertex or pole of each lens. The meniscus is the stronger lens, since its distance V_2F_2 is obviously shorter than the same distance for the biconvex lens. In other words, the meniscus brings light that is directed toward the eye to a focus sooner than does the biconvex lens. So far as

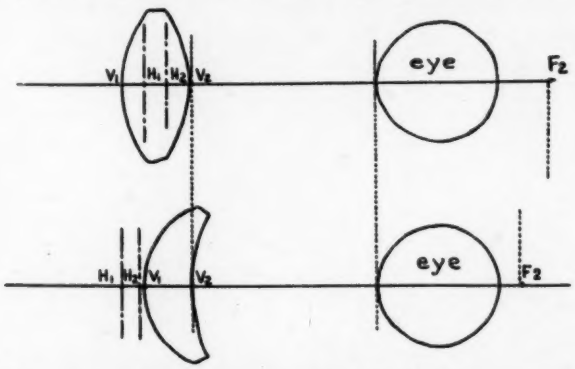

Fig. 3.—Two converging lenses, one of which is biconvex and the other a meniscus. The distance H_2F_2 (the focal length) is the same for both.

the eye is concerned, it is V_2F_2, the distance from the posterior vertex to the principal focus on the same side, that is important, and not the distance H_2F_2. For the correction of ametropia, two lenses are interchangeable only if their focal points on the eye side (F_2) coincide.

If all ophthalmic lenses were numbered so as to indicate the distance V_2F_2 (this distance is called the posterior focal intercept), then the refractive power of ophthalmic lenses would be always the same for lenses of the same numerical value, regardless of their shape or thickness. Considerations such as these led Dr. Moritz von Rohr, physicist of the Carl Zeiss Company, to originate "vertex or Scheitel refraction." He suggested that the pole or vertex of the surface of the lens nearest the cornea be used as a fixed point of orientation from which to measure the focal length of a lens. Thus, in vertex refraction the reciprocal of the posterior focal intercept, when the latter is expressed in meters, represents the lens power and is expressed by the symbol D_v. A synonymous

term for vertex power is effective power. It must be understood that, whereas the equivalent power of a lens is the same, whether the light traverses it from one side or the other, the effective power varies, except in equibiconvex or equibiconcave lenses, with the surface of the lens facing the eye. Reference to figure 2 will make this clear.

EFFECT OF THICKNESS

It has been shown that the shape of a lens affects its power. The thickness also affects the power. Prentice [1] gives the following formulas for the distances of the principal points H_1 and H_2 from the surfaces S_1 and S_2, respectively: distance $H_1V_1 = \frac{t\,r_1}{n\,(r_1 - r_2) - t\,(n-1)}$, and distance $H_2V_2 = \frac{t\,r_2}{n\,(r_1 - r_2) - t\,(n-1)}$, where r_1 and r_2 equal the radii of the surfaces S_1 and S_2, respectively, n equals the index of refraction (usually 1.5), and t the thickness of the lens. These formulas apply to a thick lens of any form when r_1 and r_2 are given the proper sign.

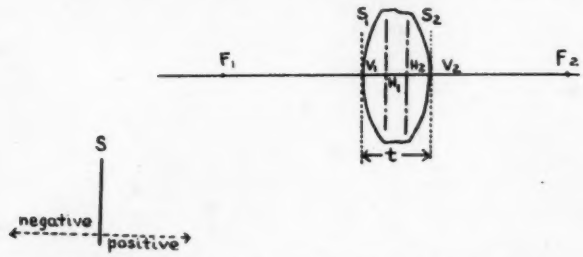

Fig. 4.—Graphic illustration of the distances in Prentice's formulas. The diagram with S (indicating the surface of curvature from which the distance is measured—either the point V_1 or V_2) and the dotted lines marked negative and positive is a scheme for determining the proper sign of a distance in the formulas.

From these formulas, it is evident that when all other factors are the same, the distances H_1V_1 and H_2V_2 increase with the thickness of a lens, because as t increases the numerator increases, while the denominator decreases. It is easy to see also that when r_1 and r_2 are equal H_1V_1 equals H_2V_2; in other words, in an equibiconvex lens each principal point is equidistant from its corresponding surface. In the case of a meniscus lens (figure 2*B*), H_1V_1 becomes negative (because r_2 is numerically greater than r_1, and both take a plus sign), and thus H_1 is located outside the lens in front. Likewise, H_2V_2 is negative and lies to the left of V_2.

1. Prentice, C. F.: Ophthalmic Lenses and Prisms, Chicago, Cleveland Press, 1917. (Reprint of an essay contributed to Wood, C. A.: the American Encyclopedia of Ophthalmology, Chicago, Cleveland Press, 1917, vol. 10.)

The formula for the principal focal length of a thick lens is given by Prentice as $f = \frac{r_1 r_2}{(n-1)(r_2 - r_1) + \frac{t(n-1)^2}{n}}$. Since the index of refraction of crown glass is 1.5, this simplifies to $f \frac{r_1 r_2}{\frac{1}{2}(r_2 - r_1) + t/6}$. By substituting

TABLE 1.—*Effect of Thickness on Focal Length, Equivalent Power and Vertex Power in Equibiconvex Lenses* *

r_1 and r_2 Mm.	Thickness (t), Mm.	Distance (H_1V_1 or H_2V_2), Mm.	Focal Length (f), Mm.	Equivalent Power (D), Diopters	Vertex Power (Dv), Diopters	Comment
100	5	1.7	100.8	9.92	10.00	Ordinarily, an equiconvex lens of 10 diopters is about 5 mm. thick;† doubling the thickness does not change appreciably either the equivalent power or the effective dioptric value
100	8	2.7	101.3	9.87	10.14	
100	10	3.4	101.7	9.83	10.17	
80	6	2.0	81.0	12.35	12.66	Even in the highest powers of equiconvex lenses, an increase of thickness has only a negligible effect on the power; note the difference between the vertex (effective) powers and the equivalent powers
80	10	3.4	81.7	12.24	12.77	
60	7	2.4	61.2	16.34	17.01	
60	10	3.4	61.7	16.21	17.15	

* In the tables, r_1 is the radius of curvature of the first surface of the lens, and r_2 of the second surface. The back focal intercept, or the intercept on the image side, is the distance V_2F_2; the reciprocal of this, expressed in meters, is the effective or vertex power.

† Percival (The Prescribing of Spectacles, New York, William Wood & Company, 1928) wrote: "Practically a fairly good estimate of the thickness of a lens of any power D, the greatest diameter of which is 40 mm., can be obtained by using the empirical rule: $t = I + .4D = 5$ mm., if $D = 10$."

TABLE 2.—*Effect of Thickness on Focal Length, Equivalent Power and Vertex Power in Converging Menisci*

r_1, Mm.	r_2, Mm.	Thickness (t), Mm.	Distance (H_2V_2), Mm.	Focal Length (f), Mm.	Equivalent Power (D), Diopters	Vertex Power (Dv), Diopters	Comment
32	70	4	—4.7	113.9	8.78	9.09	In meniscus lenses, increasing the thickness in the stronger lenses does affect appreciably the power of the lens; also, there is a marked difference between vertex power and equivalent power
32	70	8	—9.2	110.2	9.07	9.90	
40	70	3	—4.5	180.6	5.54	5.68	In lenses of this strength, thickness has only a small effect on power; the difference between the vertex power and the equivalent power is just beginning to become noteworthy
40	70	4	—5.9	178.7	5.60	5.78	
40	70	5	—7.4	176.9	5.65	5.89	

definite values in the foregoing equations, the reader can determine for himself just how the thickness of a lens influences the focal length and thereby the equivalent power. The effective power may be obtained by subtracting from the focal length (expressed in meters) the distance H_2V_2, and then taking the reciprocal of this quantity. The calculations in tables 1 and 2 were determined in this manner.

THE DIVERGING LENS

For minus lenses, it is the distance from the vertex nearer the eye to the principal focus in front of the lens (the distance V_2F_2 in figure 2) that is important. In myopia, the far point of the eye is located at a finite distance in front of the eye; the greater the myopia the shorter this distance is. The object of a correcting lens is to render parallel rays as divergent as though they came from the far point. Thus, if a lens worn at the usual distance before a myopic eye is of such strength that its principal focus on the side away from the eye coincides with the far point, then that lens corrects the myopia exactly (figure 5).

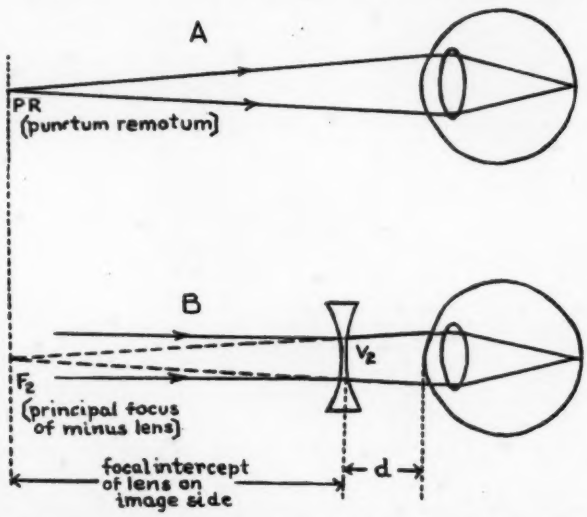

Fig. 5.—Diagram of uncorrected vision (*A*) and corrected vision (*B*) in a myopic eye. All minus lenses having the same focal intercept, when worn at distance d from this eye, are interchangeable, regardless of their contour. PR indicates the punctum remotum.

It may be well, while the reader refers to figures *2D*, *2E* and *2F*, to mention a few points: For each lens distance, F_2H_2 equals F_1H_1, which equals the focal length; these two distances are always equal, regardless of the form of the lens. F_2V_2 is the focal intercept on the image side and is the most important distance pertaining to a diverging lens from the ophthalmic point of view. F_1V_1 is the focal intercept on the object side and is not important. These last two distances, F_1V_1 and F_2V_2, are equal only in the case of an equal-sided concave lens. The reciprocal value of the focal intercept on the image side (reciprocal of F_2V_2) is the vertex or effective power. For converging lenses, the distance F_2H_2 is always greater than F_2V_2, or, in other words, the equivalent power is always less than the vertex power. In diverging lenses this is not

always the case: for an equibiconcave lens the equivalent power is greater than the vertex power; in a diverging meniscus it is less, and in a planoconcave lens the two are equal.

Diverging lenses are made very thin at the middle in order to limit their weight. Those with a power above 15 diopters are usually only 0.5 mm. thick at the middle. Those of weaker power are somewhat thicker. A lens of minus 1 diopter is usually about 1.5 mm. thick at the center. Because of this, the principal points are situated so close to the vertices that the differences between principal point and vertex refraction are negligible. In a diverging meniscus lens of a power as high as minus 20 diopters, the difference between the equivalent power and the vertex power is less than 0.12 diopter.

TABLE 3.—*Effect of Thickness on Focal Length, Equivalent Power and Vertex Power in Diverging Lenses*

Type of Lens	r_1, Mm.	r_2, Mm.	Thickness (t), Mm.	Distance H_1V_1, Mm.	Distance H_2V_2, Mm.	Focal Length (f), H_1F_1 or H_2F_2	Equivalent Power (D), Diopters	Vertex Power (Dv), Diopters	Comment
Biconcave	−50	+50	1.0	+0.33	−0.33	49.83	−20.07	−19.94	This shows the negligible influence of thickness in biconcave lenses, also the negligible difference between vertex refraction and principal point refraction
Biconcave	−50	+50	0.5	+0.17	−0.17	49.92	−20.01	−19.97	
Diverging meniscus	+80	+40	1.0	Irrelevant	0.70	161.40	−6.20	−6.22	Note the insignificant differences between effective power and equivalent power

PRACTICAL ASPECTS OF VARIATIONS IN FORM AND THICKNESS

The differences between equivalent power and effective power start to become noteworthy in converging menisci of 6 or more diopters and in equiconvex lenses of 10 diopters or more. As a rough general rule, it may be stated that for converging menisci of 6 diopters or more, the thickness of the lens appreciably affects the vertex power. In equiconvex lenses, thickness need not be considered. In the case of ophthalmic diverging lenses, thickness may be ignored; form may be ignored also, because in the particular shapes used in ophthalmic practice the differences between effective power and equivalent power are insignificant.

Fortunately, almost all modern lenses, both trial and correcting, are now labeled in terms of vertex power, regardless of their form. This includes the commonly used flat lenses of the trial cases. Therefore, no attention need be paid to either form or thickness. However, the dis-

tance between the rear pole of the trial lens and the cornea must be measured and considered as must the separation of lenses in the trial frame.

DISTANCE OF LENS FROM THE EYE

Both the power of a lens and the size of the retinal image vary with the distance from the eye at which a lens is worn. Theoretically, a lens should be worn at the anterior principal focus of the eye, in which case the images formed on the retina are of the same size as in emmetropia. This distance is 15.7 mm. in front of the cornea, but usually it is not adhered to, glasses being fitted as close to the eyes as the lashes permit—usually at a distance of about 13 or 14 mm. Wearing the center of a convex lens nearer the eye than the anterior principal focus reduces the size of the retinal image; in the case of a concave lens the retinal image becomes larger. The opposite effect is produced when a lens is worn with its center farther than 15.7 mm. from the cornea.

It is well known that concave glasses are weakened and convex glasses strengthened by moving them farther from the eyes. The converse is true as they are brought closer to the eyes. Sheard [2] gives the following formula for computing the numerical effect of changing the position of a lens before the eye: $C = 0.001\ s\ D^2$, where C equals the change in effectivity, s the distance in millimeters that the lens is moved and D the dioptric power of the lens.

This useful formula should be memorized by oculists. For example, if a minus 15 diopter sphere should be fitted by the optician 3 mm. farther from the eye than the oculist's lens in the trial frame, the lens the laboratory findings nor the investigators' results have placed the problem outside $\overline{15}^2 = 0.675$ D.), and the patient would not see as well as at the time of refraction.

In the trial frame, a cylinder and a sphere necessarily must be separated. When worn as a correcting lens, they have been combined into one; in other words, the cylinder has been moved nearer the eye—into the plane of the sphere, as it were. Therefore, when a strong cylinder is used with a sphere in the trial frame (assuming, as is usually the case, that the cylinder is placed in front of the sphere), the distance separating the centers of the two lenses should be measured, and the effectivity of the cylinder in the plane of the sphere should be computed by means of the formula just given. Most modern trial frames contain a gage which shows the distance of the rear cell from the cornea. Remembering that the optician will probably fit the frame as close to the cornea as the cilia permit, the oculist should either calculate the power at that distance or state on his prescription blank at what distance the prescribed strength was worn in the trial frame, in which case the optician can make the

2. Sheard, Charles: Some Fundamental Principles of Modern Ophthalmic Lenses, Am. J. Physiol. Optics **6**:34, 1925.

necessary allowances. Some of these calculations, of course, can be avoided by putting the trial frame combination of lenses into a lensometer and reading off the vertex power of the combination. The distance from the posterior vertex of the rear lens to the cornea, however, must still be noted.

Sheard also uses the formula just given for calculating the effective or vertex power of an ophthalmic lens when the power of the two surfaces, which may be obtained with a watch-dial spherometer (Geneva lens measure), and the thickness of the lens are known. The first surface of a lens may be thought of as having been displaced forward from the position of the second surface by an amount equal to the thickness of the lens. Since a thick lens may be regarded as being composed of two ideally thin lenses separated by a medium of glass, the back-focal or vertex power may be determined by finding the change in effectivity of the power D_1 (more remote from the eye), if the latter is shifted distally from a position that D_2, the surface proximal to the eye, occupies. Thus, $D_B = D_1 + D_2 \pm \frac{0.001\ t\ D_1^2}{n}$, where D_B is the effective power, D_1 the dioptric power of the surface distal to the eye, D_2 the dioptric power of the surface proximal to the eye, and t the thickness of the lens in millimeters, and n the index of refraction of the glass. The plus sign indicates the result when D_1 converges; the minus sign, that when D_1 diverges.

As an example, in the application of this formula, take the lens given in table 2, in which r_1 is 40 mm., and r_2, 70 mm., and t equals 4 mm. The formula $D = \frac{1}{f} = \frac{1}{2r}$, taken from elementary physics, in which D indicates the dioptric power of a surface, f the focal length expressed in meters and r the radius of curvature expressed in meters, will enable one to obtain the dioptric powers of the two surfaces. Thus, $D_1 = \frac{1}{2 \times \frac{40}{1{,}000}} = +\ 12.50$ D, and $D_2 = \frac{1}{2 \times \frac{70}{1{,}000}} = -\ 7.14$ D, $\therefore D_B = +\ 12.5 - 7.14 + \frac{0.001 \times 4 \times \frac{625}{4}}{1\frac{1}{3}} = 5.78$ D. This figure agrees with that for the vertex power obtained by another method.

NEUTRALIZATION

The commonly practiced method of neutralization, whereby two lenses are held in apposition and then moved before the eye to see if external objects are displaced, is subject to several fallacies. One lens may be said to neutralize the effect of another if rays of light which are parallel before traversing the first lens emerge from the second lens in the same state, thus making the net effect on the light passing through the two lenses similar to the effect of passing through a plate of glass. The rays may be displaced laterally, but there is no converging or diverging action.

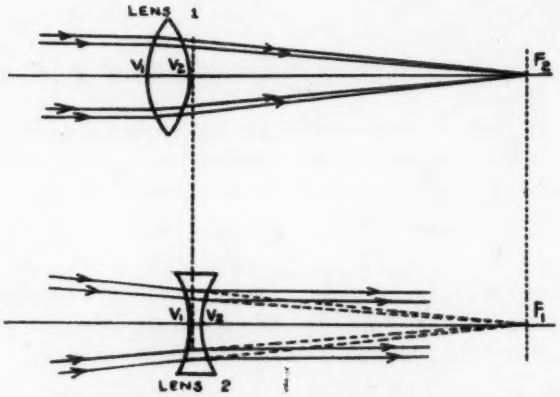

Fig. 6.—Neutralization by means of two equal-sided lenses with the same focal intercepts.

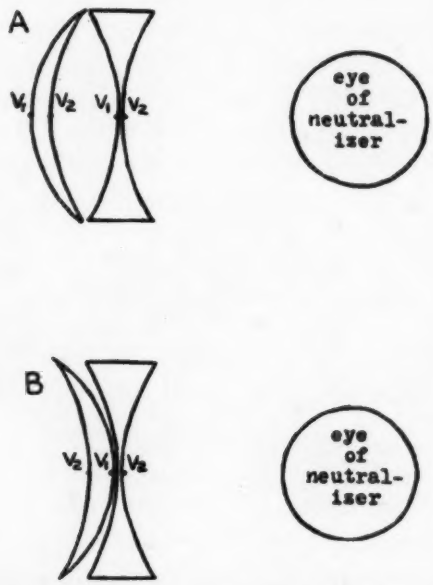

Fig. 7.—Diagrams showing: *A*, proper position for a converging meniscus that is being neutralized, and *B*, improper position, which will measure the wrong focal intercept (V_1F_1).

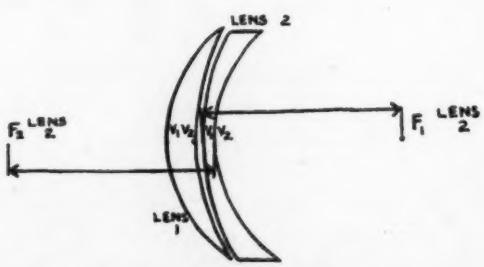

Fig. 8.—Diagram showing attempted neutralization of a converging meniscus (lens 1) with a contrameniscus (diverging meniscus). The latter (lens 2) is labeled to represent the reciprocal of the distance F_2V_2, not the distance V_1F_1 (which is unknown) which governs the neutralization of lens 1.

In figure 6 there are depicted schematically two lenses of equal sides with the same focal intercepts (same numerical effective power). Since the lenses are equal-sided, the two focal intercepts of each lens (V_1F_1 and V_2F_2) are equal. Parallel rays of light that enter the converging lens are refracted to a focus at F_2. Convergent rays which before entering the diverging lens are directed to a focus at F_1 are diverged, so that on leaving the lens they are parallel. If the second lens is placed behind the first, so that the adjacent vertices (V_2 of lens 1 and V_1 of lens 2) are in contact, then F_2 of lens 1 will coincide with F_1 of lens 2, and the combination will neither converge nor diverge light traversing it.

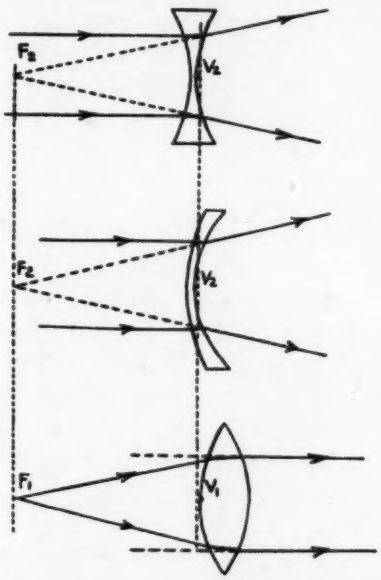

Fig. 9.—Diagram showing neutralization of diverging lenses.

If lens 2 is held too far behind lens 1, so that an interval of air separates the two adjacent vertices, F_2 of the plus lens will lie in front of F_1 of the minus lens, and the resultant effect of the combination will be a convergent action. The greater the separation the stronger the convergence will be. Thus it is seen that two opposite lenses with the same focal intercepts neutralize only while the proper vertices are in contact. If lens 2 had a shorter focal intercept than lens 1 (numerically stronger and also opposite in sign), then a certain interval of air would have to separate the two lenses in order that the second might nullify the effect of the first, as F_2 of lens 1 and F_1 of lens 2 must coincide when neutralization occurs. This, however, would not measure the vertex power of the first lens.

So long as one is dealing with equal-sided lenses, it does not matter which surfaces are apposed, since both intercepts of such a lens are equal. However, most converging spectacle lenses are in the meniscus form. Since the posterior focal intercept of a convex lens (the distance V_2F_2) is the one that is significant, and as the two focal intercepts in the higher-powered meniscus lenses may vary by as large an amount as several diopters, the importance of neutralizing the proper intercept is obvious.

A lens that is to be neutralized should be held before the eye of the observer just as it is worn by the patient (fig. 7). The neutralizing lens should be held directly behind and against the first lens. Unfortunately, because of the shape of a converging meniscus, it is impossible to bring the adjacent vertices of the two lenses into contact. Therefore, it is impossible to neutralize exactly a converging meniscus with the ordinary biconcave lenses of the trial cases. Nor would it be possible to use a contrameniscus (diverging meniscus) if such a lens were available. A diverging meniscus is labeled to represent the reciprocal of the distance V_2F_2, not the distance V_1F_1, which is the one that governs the neutralization.

Similar difficulties are encountered in neutralizing diverging lenses (fig. 9). First, there is the impossibility, because of the shape of the lenses, of getting the pole V_1 of an equibiconvex lens exactly against the pole V_2 of a diverging lens, especially the diverging meniscus. Second, converging menisci cannot be used, because the anterior focal intercept (V_1F_1) of such a lens is not known, and this is the distance that governs the neutralization.

The spherometer (Geneva lens measure) is unsatisfactory also. First, it gives merely the curvature of the surface. It has been shown that the power of a lens may vary considerably from the algebraic sum of the two surfaces. Second, it is calibrated for crown glass. Some lenses, particularly those with high minus power, are made from flint glass.

This leaves only the lensometer as an accurate means of measuring the vertex power of a lens. In addition to being accurate, this instrument is time-saving.

News and Notes

GENERAL NEWS

Annual Course, Research Study Club of Los Angeles.—The Research Study Club of Los Angeles will present its fourth annual course from Jan. 21 to Feb. 1, 1935, in Los Angeles. The guest lecturers in ophthalmology will be Dr. Webb Weeks of New York, who will give a course in operative surgery on the cadaver, and Dr. Harry Gradle of Chicago, who will discuss the subjects of glaucoma, uveitis and recent advances in ophthalmology. For a detailed program of the course and for further information address Dr. Don Dryer, 2007 Wilshire Boulevard, Los Angeles, Calif.

Alfred Eichholz Memorial Clinic.—On July 6, the Prince of Wales opened the Alfred Eichholz Memorial Clinic at London, a memorial to Dr. Alfred Eichholz donated by his cousin, Mr. W. Eichholz. This clinic will serve as one of the important activities of the National Institute for the Blind, and will utilize the services of blind masseurs who have been trained under the direction of the Institute to render service under medical supervision to patients wishing private treatment.

SOCIETY NOTES

National Society for the Prevention of Blindness.—The annual meeting of this society will be held on Dec. 6, 1934, in New York. The principal address will be made by Dr. Edward Jackson of Denver, a member of the board of directors. Dr. Jackson is to speak on "Wide Basis for Blindness Prevention."

UNIVERSITY NOTES

During the week of Jan. 14 to 19, 1935, a course will be given at the Northwestern University Medical School on the diagnosis and surgical and nonsurgical treatment of strabismus, including dissection on the cadaver. Half the day will be spent in lectures and demonstrations and the other half in the hospital, the orthoptic clinic and the laboratory of surgical anatomy. Attendance will be limited to fifteen persons, and accommodations for those desiring them will be arranged at the Lake Shore Athletic Club.

Other courses in ophthalmology for larger or smaller groups will be given during the month of January by various teaching institutions in Chicago. Detailed information may be obtained from Dr. Sanford Gifford, Northwestern University Medical School.

The University of Buffalo Gold Medal is awarded annually to the author of a work on an ophthalmic subject. Details may be learned by addressing Dr. H. W. Cowper, 543 Franklin Street, Buffalo.

Correspondence

RETINITIS PUNCTATA ALBESCENS AND RETINITIS PIGMENTOSA AS AFFECTED BY PREGNANCY

To the Editor:—With reference to Dr. Henderson's article, "Retinitis Punctata Albescens and Retinitis Pigmentosa as Affected by Pregnancy" (ARCH. OPHTH. 11:763 [May] 1934), the author stated that "some authorities believe that consanguinity has been given too prominent a place in the etiology," and he quoted the "American Encyclopedia and Dictionary of Ophthalmology," by Wood, in support. The statement contained therein that retinitis pigmentosa is found frequently among the Hindus for whom consanguineous marriages are prohibited by religion is referred to. I feel almost sure that the contributor is unwittingly helping to perpetuate an error and trust that he will forgive my drawing attention to it in connection with his interesting article. The bald statement is made in the "Encyclopedia" that "the influence of consanguinity has been overestimated," without other apparent authority than an inference based on the lines which follow, that Macnamara has shown that the disease is not infrequent among the Hindus whose religion prohibits intermarriage. If there is no other authority, the statement is incorrect. Both of Macnamara's statements are true, but the argument based on them is false. Retinitis pigmentosa and the other tapetoretinal degenerations are common among the Hindus whose religion prohibits intermarriage, but this tenet of Hinduism is more honored in the breach than in the observance; hence the fallacy. As Kirkpatrick has pointed out, consanguineous marriages are exceedingly common (87 per cent) in the cases of retinitis pigmentosa seen in the Madras Presidency, South India, where the vast bulk of the patients are Hindus, and retinitis pigmentosa and allied conditions constitute 21 per cent of the diseases of the choroid and retina. Julia Bell, in the "Treasury of Human Inheritance," volume 2 (Cambridge Univ. Press 1922), gives an idea of the relative influence of consanguinity in this connection.

ROBERT E. WRIGHT, M.D., C.I.E., LIEUT.-COL., I. M. S.,
Superintendent, Government Ophthalmic Hospital, Madras, India.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Anatomy and Embryology

THE MUSCULUS ORBITALIS IN MAN. L. ERNYEI, Arch. f. Ophth. **131:** 389 (Dec.) 1933.

The position and the extent of the musculus orbitalis were determined on several human cadavers of various ages (from 20 to 60 years) by macroscopic dissection and also by microscopic examination of serial sections. Ernyei found the muscle to be from 3 to 4 mm. long and from 1 to 2 mm. wide. It formed a bridge across the posterior portion of the lower orbital fissure. The muscle was divided into small bundles by fat and connective tissue. No elastic fibers could be found within the muscle. The ophthalmic vein lay outside of the muscle. Ernyei concludes that the musculus orbitalis has only the function of partly closing the inferior fissure. It cannot influence in any way the position of the globe in the anterior-posterior direction. P. C. KRONFELD.

Conjunctiva

THE FORMATION OF TUBERCLES IN SPRING CATARRH. C. PASCHEFF, Arch. d'opht. **50:** 670 (Oct.) 1933.

In a previous report Pascheff demonstrated not only the relationship between spring catarrh and lymphatism but also its relationship to latent tuberculosis. In the present paper he describes a series of four cases in which a microscopic examination of excised nodules was made in addition to the general investigation of the patient. The observations lead him to point out that latent tuberculosis, as evidenced by enlargement of the tracheobronchial lymph nodes, is rather frequent in spring catarrh. The conjunctival nodules he believes are epithelioid tubercles with rapid necrosis of their giant cells. The lack of a lymphocytic reaction is in favor of their endogenous origin. They disappear without ulceration and leave no scar. He suggests that spring catarrh may be an anaphylactic tuberculous reaction. In his opinion this point of view merits further study. S. B. MARLOW.

TREATMENT OF VERNAL CONJUNCTIVITIS. A. TORRES Y TORRES, Rev. cubana de oto-neuro-oftal. **6:** 277 (Nov.-Dec.) 1933.

Torres states that there are few ocular diseases in which such inefficacy of treatment obtains as in the conjunctivitis poorly named "vernal," and that this is due to lack of knowledge concerning its causation. He cites the various etiologic theories of many authors.

His conclusions are based on a study of thirty-seven cases in which vagotony, consanguinity, arthritis, heredity, helminthiasis, humidity, heat, light, allergy and syphilis played no etiologic rôle. In all of the cases there was a familial history of tuberculosis, medical or surgical, alcoholism and general physiologic impoverishment. Roentgenograms showed hilar adenopathy, generally bilateral, of the fibrocaseous type.

Discussing the many forms of treatment utilized by others, each of which he has tried to no avail, he outlines his own procedure: rest, nutritious food and fresh air; dark glasses, with correction of any existing ametropia, and intravenous injections of some form of calcium every third or fourth day during two months in the spring and a like period in the autumn, even though in one or the other period the condition is quiescent. For hospital patients he prescribes this powder: calcium phosphate, 3 Gm., calcium carbonate, 3 Gm., and lactose, 1 Gm. From 1 to 10 such powders are given daily. Phosphorus and phosphorized cod liver oil are employed; in certain cases, the arsenicals and iodides. No collyria are used except in those cases in which an associated conjunctivitis is encountered. Large vegetations are cut off; smaller ones are cauterized.

The results of the treatment are: Thirty-one patients cured. The remaining six patients, in whom the condition is of slightly more than a year's standing, are still under treatment. S. L. RHODE.

HARD CHANCRE OF THE BULBAR CONJUNCTIVA. J. M. RENEDO and F. R. GONZALVEZ, Rev. cubana de oto-neuro-oftal. **6**: 286 (Nov.-Dec.) 1933.

A woman of 55 years attempted to remove what felt like a foreign body in the right eye by repeated brushings of the conjunctiva with the corner of a handkerchief. Twenty-five days later she presented a large reddish tumefaction of the mucous membrane of the lower half of the globe; the swelling was indurated, not painful, and oval with flattened borders; its central surface was raised and covered by a grayish-white plaque resembling a pseudomembrane. The lids were swollen; the patient was unable to close them. There was a slight upward displacement of the eyeball; the muscle movements were full except for some limitation of downward rotation. The preauricular gland was not palpable; the submaxillary gland was enlarged. Dark-field examination of scrapings from the mass showed many spirochetes. The Wassermann test was negative.

The case is reported because of the extreme rarity of chancre in this part of the eye. When the eye is involved it is usually the lid that is affected. In those cases in which the mucous membrane is affected, the sites of involvement, in the order of frequency, are the internal angle (especially the semilunar fold), the conjunctiva of the lower lid and lower culdesac, the external angle and the conjunctiva of the upper lid, and the conjunctiva of the globe. S. L. RHODE.

HISTOLOGY OF THE INVOLVEMENT OF THE CONJUNCTIVA IN SUMMER PRURIGO. REPORT OF A CASE. R. BEZECNY and S. BIERINGER, Klin. Monatsbl. f. Augenh. **91**: 810 (Dec.) 1933.

The differential diagnosis of summer prurigo and hydroa vacciniforme is given, and the case of a woman, aged 32, suffering with summer prurigo and conjunctival complications is reported. She had had the eruptions of the skin since her eighth year of life. They appeared for the first time in the fall and reappeared every February from the following year on. The ocular changes began in her seventeenth year. They were surgically treated seven years later, but remained unchanged in

recent years. Scars did not exist. Itching was severest on the forearms, face, forehead, nose, chin, cheeks and neck. The skin at these locations showed lichenification, scratches and nodules, some of which were as large as peas. In 800 cc. of urine 1 mg. of hematoporphyrin was found, which occurs rarely in summer prurigo, but frequently in hydroa. The conjunctiva bulbi in the temporal portion of the palpebral fissure in each eye was transformed into a vascularized, soft, yellowish-white mass, measuring in height about 1 mm. near the corneal margin. A cystoid structure was evident, the largest cysts appearing at the lower limbus, where they extended into the cornea, the clear portion of which was separated by a line resembling a gerontoxon. The conjunctiva tarsi was normal in both eyes.

Proliferation of the epithelium was the most striking histologic feature; it resulted in the formation of the cysts and tubes. The cysts extended into the connective tissue and were lined with several strata of epithelial cells; some of them seemed empty while others were filled with a detritus of epithelial cells. The cysts seemed to have originated by folding of the epithelium. Some of the upper layers of the epithelium had undergone intercellular edematous changes (spongiosis), interspersed with numerous round cells and isolated eosinophil leukocytes. The parenchyma of the cornea and Bowman's membrane stained red with sudan. Similar changes occurring in the conjunctiva in complication of hydroa and of summer prurigo suggest that these two diseases are related.

K. L. Stoll.

Comparative Ophthalmology

Musculus Retractor Bulbi (Oculi) in Carnivora and Ungulata. O. C. Bradley, J. Anat. **68**: 65 (Oct.) 1933.

Bradley found that the musculus retractor bulbi in the cat and the dog had been amply described by many others, but that no one had investigated the muscle in other carnivora. He examined the following animals: racoon (Procyon lotor), Japanese bear (Ursus japonicus), sloth bear (Melursus labiatus), jackal (Canis aureus), lion (Felis leo), ocelot (Felis pardalis), puma (Felis concolor), snow-leopard (Felis uncia) and lynx (Felis lynx). Of this collection, only the raccoon and the sloth bear showed notable variations from the disposition of the muscle in the domestic dog and cat. The Ungulata, however, exhibit unexpected differences. The following were examined: vicugna (Auchenia vicugna), reindeer (Rangifer tarandus), black brick (Antelope cervicapra), gaur (Bos gaur) and buffalo (Bos americanus). Bradley believes that since only two exceptions to the rule have been found in the Carnivora it is reasonable to suspect that there are others. In the Ungulata he found a varying number of bundles of fibers of varying sizes, and thus he reaches the conclusion that the pattern of insertion varies in different members of the same species and even in the two eyes of an individual animal. A bibliography is added.

L. L. Mayer.

The Ocular Findings in Marek's Paralysis of Chickens. P. A. Jaensch and K. Lerche, Arch. f. Ophth. **131**: 359 (Dec.) 1933.

Marek's paralysis of chickens is an infectious inflammatory disease affecting the central and the peripheral nervous system. The diseased

animals frequently manifest visual disturbances, which are caused by a severe iridocyclitis. Jaensch and Lerche studied anatomically thirty-seven eyes from twenty-two animals. Usually both eyes were affected. The iris was thickly infiltrated with round cells; the sphincter and the pigmented epithelium were being destroyed; the physiologic fat in the muscle was atrophied. The choroid was very hyperemic and also infiltrated, so that it looked like the human choroid in lymphatic leukemia. The retina became involved secondarily. Optic nerve and chiasm were invaded by lymphocytes and histiocytes. P. C. KRONFELD.

Cornea and Sclera

IS THE PIGMENT OF THE KAYSER-FLEISCHER CORNEAL RING OF SILVER? W. GERLACH and W. ROHRSCHNEIDER, Klin. Wchnschr. 13: 48 (Jan. 13) 1934.

Fleischer left the question open, while Hall felt that the pigment was similar to that found in malaria. Kubik called it a type of degenerated pigment. Vogt reiterated Rumpel's claim that the pigment is silver and gave the following three arguments for his belief: 1. In tissue preparations, 1 drop of 10 per cent potassium cyanide causes a disappearance of the dark brown pigment. 2. Compound solution of iodine brings out the pigment in the tissues, and alcohol renders it again indistinguishable. With use of the photographic developer, hydroquinone, the pigment is seen again. 3. Analyses of sclera, liver, kidney and spleen show large amounts of silver and some copper.

Gerlach and Rohrschneider have shown that malarial pigment and formaldehyde pigment give like silver reactions to potassium cyanide. They were unable to get the reaction as Vogt did with compound solution of iodine and hydroquinone. No colored material was found in the sclera of their patient, and the analysis for silver gave a negative result.

By means of a spectrographic method developed by Gerlach, the Fraunhofer lines of copper were found in the cornea and little evidence of silver. The liver had copper, much iron and no silver. They conclude that in the case which they studied the pigment of the Kayser-Fleischer ring not only was not silver but was entirely free from silver. The amount of copper is now being investigated. A bibliography accompanies the article. L. L. MAYER.

Experimental Pathology

AN EXPERIMENTAL STUDY OF CORNEAL VASCULARIZATION. L. A. JULIANELLE, M. C. MORRIS and R. W. HARRISON, Am. J. Ophth. 16: 962 (Nov.) 1933.

The authors remark that while the transfer of the follicular manifestations of trachoma to apes and monkeys is accomplished with relative facility, the reproduction of the corneal reaction of cloudiness and pannus has never been attained. The experiments undertaken were predicated on the concept that the development of pannus in trachoma may be in response to a specific bacterial hypersensitiveness. The experimental data indicate that Staphylococcus aureus possesses the most

effective sensitizing antigen and that the most consistent corneal reactivity is obtainable by direct sensitization of the scarified cornea. When sensitized, the corneas of rabbits and monkeys showed marked clouding and vascularization. That this clouding and vascularization were in response to hypersensitiveness rather than to infection was demonstrated by experiments which showed that egg albumin or bacterial proteins induce a similar reactivity. No correlation could be determined between corneal reactivity and cutaneous reactivity to the same antigen. Similarly no evidence was obtained to show that the corneal reaction to hypersensitiveness is dependent on circulating antibodies.

W. S. REESE.

General Pathology

THE IMPORTANT RÔLE OF CHOLESTEROL IN OCULAR PATHOLOGY. CANTOUNET, Arch. di ottal. **40:** 451 (Nov.-Dec.) 1933.

Basing his investigation on the work of his pupil Briant, Cantounet reports on the blood cholesterol as found in various ocular diseases. The normal amount is taken as 1.6 Gm. per thousand cubic centimeters. Eight cases of retinitis with exudate showed 3.5, 3.2, 3, 2.8, 2.7, 2.68, 1.59 and 1.3 Gm. Some cases of arcus senilis showed a slight increase, up to 2.98, but many showed normal amounts. Cases of xanthelasma showed the largest amounts, 5.5, 3.7, 3.15, 2.8, 2.6 and 1.82 Gm. Most cases of synchysis scintillans showed increases, though in a few the amounts were normal. Patients with senile cataract showed moderate increases in blood cholesterol, and extracted cataractous lenses showed a marked increase to ten times the normal. Glaucoma and a few other conditions were found associated with a slight increase but apparently not with enough to be considered of importance. S. R. GIFFORD.

Glaucoma

THE RELATIONSHIP OF HISTAMIN AND INTRAOCULAR PRESSURE. B. W. RYCROFT, Brit. J. Ophth. **18:** 149 (March) 1934.

Rycroft points out that the predisposing causes of acute glaucoma have long been known, but that the exciting causes are less understood. They are intimately related to the nervous control of the ocular capillaries and to a disturbance of intra-ocular osmotic equilibrium. It has been his object to investigate possible immediate causes of this vascular disturbance and to correlate laboratory findings with clinical observations.

The problems which seemed to require investigation were: the effect of histamine on the intra-ocular pressure of the normal eye; the identification of histamine in the aqueous in cases of acute glaucoma.

The properties and physiologic action of histamine are first stated and then the experimental evidence is adduced. Four cases of primary acute glaucoma are selected in an endeavor to correlate the experimental results with the clinical findings.

The conclusions arrived at are that the effect of histamine on animal eyes varies according to the species; that the injection of histamine into the eye of a cat will produce per se a rise of intra-ocular pressure independent of that due to its own volume; that in cases of acute glaucoma there is present in the aqueous a vasotoxic substance the nature of

which at the moment is indeterminate; it is possibly histamine substance or is related to it. It is proposed to extend the clinical evidence further as no final conclusions can be based on three positive cases, and to investigate the parallel effects of acetylcholine, which may also play a part.

W. ZENTMAYER.

Hygiene, Sociology, Education and History

PREVENTION OF HEREDITARY CONDITIONS OF THE EYE. B. FLEISCHER-ERLANGER, München. med. Wchnschr. **81**: 17 (Jan. 5) 1934.

Fleischer-Erlanger tells of his previous investigations of this subject, which has become of more acute importance because of the question of sterilization of persons whose descendants may have transmitted to them one of many such defects of the eye.

The mendelian theory is used as a basis, and the literature of the past with its statistics as to hereditary conditions of the eye is dwelt on in detail. The author adds the following classification of the various conditions of the eye as to hereditary possibilities:

	Recessive	Dominant	Dominant but Irregular	Recessive Sex-Linked
Retina				
	Retinitis pigmentosa	Certain forms of retinitis pigmentosa	Some macular degenerations	One form of retinitis pigmentosa
	Degeneration of macula lutea	One form of detachment	Lindau's disease	One form of macular degeneration
	Aplasia maculae with nystagmus			
	Glioma	Glioma	.....	Partial albinism with macular loss
	Amaurotic idiocy			
	Total color blindness	.....	.....	Hemeralopia and myopia
				One form of myopia
Pupil and Lens				
	Ectopia pupillae	Aniridia	Iridic and other coloboma	Atrophy of iris, with glaucoma
	Ectopia pupillae et lentis	Ectopia lentis		
	Ectopia lentis	Spontaneous luxation of lens	Flocculi iridis	
	Microphthalmia	Luxation from arachnodactylia		
	One form of congenital juvenile zonular cataract	Microphthalmia with myopia and ectopia of pupil		
	Cataract with hydrocephalus and microphthalmia	More forms of cataract (also myotonia)		
Cornea				
	Keratoconus	Familial degeneracy	Microcornea	Megalocornea
	Cornea plana	Blue sclera	Astigmatism	
Muscle				
	Ptosis and muscle paralyses	Isolated ptosis	Strabismus convergens	One form of nystagmus
	Cryptophthalmus	Ptosis and blepharophimosis	Nystagmus	
	Anophthalmos	Ptosis and ophthalmoplegia		
Glaucoma				
	Juvenile with keratoconus	Distichia epicanthus glaucoma	.....	One form of microphthalmia with blindness

L. L. MAYER.

Lens

CONTRIBUTION TO THE PROBLEM OF ENZYME-ACTION IN THE MECHANISM OF CATARACT. A. SAUERMANN, Am. J. Ophth. **16:** 985 (Nov.) 1933.

The etiology of cataract from the standpoint of the autolytic action of enzymes forms the basis of this paper. The following summary is given:

"The p_H of normal cattle lenses and of human cataractous lenses was determined, averaging 7.4 and 6.2, respectively.

"There is no free tyrosin in normal cattle lenses but free tyrosin is present in cataractous human lenses.

"There is no tyrosinase, either in normal cattle lenses or in human cataractous lenses.

"There is no free tryptophan in normal cattle lenses, but there is free tryptophan in cataractous human lenses.

"The autolysis of lens protein was studied in pure lens protein solutions and in lens protein solutions together with lecithin. It has been shown that no autolysis occurs if the reaction is alkaline (p_H 7.9). Slight autolysis occurs at almost neutral reaction and autolysis increases with increasing acid reaction until p_H 6.0 is reached.

"The presence of lecithin does not influence either the rate or degree of autolysis. The presence of lecithin causes a shift in the end point of the gradually developing acid reaction to the acid side of p_H 6.0. In the presence of lecithin in greater concentrations than 0.5 per cent the flocculation of beta crystallin at its isoelectric point of p_H 6.0 is prevented. The single protein fractions do not differ in rate or degree from those of the combined fractions."

W. S. REESE.

THE MECHANISM OF SENILE CATARACT. D. B. KIRBY, Am. J. Ophth. **16:** 1041 (Dec.) 1933.

This interesting and comprehensive article does not lend itself to abstracting. The subject is discussed under the following headings: the aqueous humor; the capsule of the crystalline lens; the epithelium of the lens; the cortex of the lens; the transparency of the tissue; the nucleus of the lens; senile nuclear cataract; senile cortical cataract; posterior cortical cataract—its mechanism; anterior and posterior subcapsular cataract—their mechanism; deposition of calcium in senile cataract; the calcium metabolism of the patient with senile cataract; the cataract of tetany—its mechanism; cataract and diabetes. The following conclusions are made: The most striking feature found in considering the mechanism of senile cataract is the disturbance of permeability (1) of the ciliary epithelial membrane, (2) of the capsule of the crystalline lens, (3) of the interfibrillar diffusion spaces of the lens and (4) of the lens fibers themselves. The causes of these changes in permeability, diffusion, absorption and extrusion of fluid may be numerous and varied. More fundamental and clinical research is necessary.

W. S. REESE.

THE BIOCHEMISTRY OF THE LENS: II. A STUDY OF CATARACTA NIGRA AND CATARACTA BRUNESCENS. S. R. GIFFORD and I. PUNTENNY, Am. J. Ophth. **16:** 1050 (Dec.) 1933.

The authors give the following summary: "1. Cataracta nigra or cataracta brunescens includes extreme examples of a lens change identical with that in nuclear sclerosis. 2. This is distinguished by a relative increase in the organic solids of the lens with relation to water. 3. In this it differs definitely from cortical cataract, in which a loss of solids occurs. 4. It may hence be considered the result of normal processes allowed to go on without the intervention of pathologic changes involving death of the lens fibers. 5. The theories that the color of brown cataract is due to blood pigment or absorption of melanin from the uveal pigment are without foundation. 6. The theory that the color is due to purely physical processes of light absorption is untenable, since colored solutions may be obtained from brown cataract. 7. No evidence was found that free tyrosine or tyrosinase are present in the normal or cataractous lens. 8. Reactions with dopa indicated that a ferment capable of oxidizing dopa to melanin is present in the cataractous lens, and that greater amounts are present in brown cataract and nuclear sclerosis. 9. A theory is proposed which may explain the color of cataracta brunescens as due to the reaction of such a ferment on substances developed from the lens protein." W. S. REESE.

THE BIOCHEMISTRY OF THE LENS: III. WATER EQUILIBRIUM IN THE NORMAL AND CATARACTOUS LENS. J. E. LEBENSOHN, Am. J. Ophth. **16:** 1062 (Dec.) 1933.

This technical article does not lend itself to abstracting. Lebensohn concludes that in senile cataract there is first a dehydration followed by a marked hydration with a final tendency toward progressive dehydration, and that the water changes and all other deviations noted in the biochemistry of senile cataract are explainable simply as a result of processes conditioning, involving or ensuing from autolysis. This autolysis requires a local acidosis, which accounts for the primary loss of water in incipient cataract. W. S. REESE.

SOME IMPRESSIONS DERIVED FROM MY EXPERIENCES OF CATARACT WORK. ROBERT E. WRIGHT, Irish J. M. Sc., October 1933, p. 549.

Colonel Wright's experience comprises 20,000 cataract extractions, so that his impressions should be carefully studied in the original paper by every one interested in ophthalmic surgery. A few of the salient features are as follows:

The method of trial bandage without culture is used in selecting eyes for operation. For cleansing, the conjunctiva is irrigated with physiologic solution of sodium chloride; the roots of the cilia are swabbed with a saturated aqueous solution of trinitrophenol. If the eyes are sensitive they are anointed daily with a salve containing 2 per cent yellow mercuric oxide and given drops of 10 per cent mild silver protein twice daily for a week prior to the operation, and before operation only irrigations with physiologic solution of sodium chloride are practiced.

The O'Brien method of dealing with the temporofacial division of the seventh nerve as it lies superficial to the neck of the mandible constitutes a great advance and minimizes the necessity for skilled assistance. Another factor of great importance in the control of the patient is the retrobulbar injection of procaine hydrochloride and epinephrine, or ciliary block. This eliminates unexpected movements of the eyeball and is of assistance in obtaining confidence and repose. Substantial doses of sedatives are given for the restlessness of the patients, and there is nothing better than morphine. The patients are not kept lying flat on their backs and perfectly quiet for days, as this makes them uncomfortable and leads to unpleasant complications.

There has been a definite change in Wright's attitude toward the intracapsular extraction. Formerly the risks and complications were considered too great to admit of its adoption, and there was no evidence to show that vitreous loss or dislocation did not lead to some damage of the eye. His views gradually changed as the record of good late effects after phaco-eresis and forceps extractions accumulated, and he eventually became favorably impressed with the advantage of the intracapsular method in suitably selected cases.

A small peripheral aperture in the iris is made, as it is important to preserve a round pupil, unless the pupil is one which does not respond to the mydriatic. In discussing phaco-eresis, Wright says that it is not justifiable to teach this operation to postgraduates since it is an operation which does not suit the average operator with limited opportunities, for whom the intracapsular extraction with forceps is much better and can be attempted by any one who feels competent to do the classic extracapsular operation. The results of the forceps delivery are just as good, but in a selection of cases more limited than that for the suction pump method. The pump is expensive and requires careful attention, and the procedure calls for considerable and continuous practice, while the advantage of the forceps method lies in its simplicity. He prefers the Green cannula in phaco-eresis. In extraction with forceps Wright prefers the Elschnig type of forceps with jaws that are absolutely parallel as in a good epilation forceps.

Wright believes that "the most disappointing thing about intracapsular extraction is the relative infrequency with which immature cataracts can be removed without unjustifiable trauma. One of the greatest difficulties in cataract work is the handling of the central immature cataracts, or any variety of cataract in which the cortex is still firmly attached to the capsule, in persons with a strong zonule."

It is difficult to obtain an ideal result in the extracapsular extraction because of three menaces to success: anterior capsule, cortex and blood. He is a firm believer in the value of irrigation, which not only removes cortical remnants, but also reveals capsular tags, threads of fibrin and filaments of cortex which might otherwise pass unnoticed.

Every one is agreed that an unsatisfactory step in extracapsular operation is the capsulotomy, since it is easy to leave capsular tags in the pupillary area and in the neighborhood of the corneal endothelium or the section. Wright suggests the following two methods of dealing with the anterior capsule. The first is the Erwin capsulotomy. In making the section a large tongue-shaped flap of anterior capsule is raised with a knife as the latter is carried across the anterior chamber.

Then, after completion, this tongue of capsule is torn off at its attachment by means of a capsular forceps. This, however, is very difficult. The second method is capsulotomy by means of forceps. Wright prefers a modification of the Alexander type which is free from teeth at both the heel and the toe of the blade.

Sutures are justifiable only if their advantages outweigh the risk of their employment, but the corneoscleral suture more closely approaches surgical perfection. When applied only to the edges of the conjunctiva they are of no great advantage. Hemorrhage into the anterior chamber is a particular misfortune; pigmented bands subsequently form on the capsule, so that it is important to take great pains to exclude blood and fibrin.

In the operation for after-cataract, Wright uses a single Bowman needle, which is passed through the cornea. He has no hesitation in passing the needle through the cornea rather than the conjunctiva, and thinks that the chances of infection are not increased and that the corneal puncture has a great mechanical advantage. It is important to clean the needle point of vitreous before withdrawing the instrument from the eye. If the membrane is too rigid or thickened for the Bowman needle, he uses the Ziegler needle or the pince-ciseaux.

In conclusion Wright speaks of the prevention and the nonoperative treatment of cataract. He thinks that not much progress has been made in recent years in the search for metabolic and other disturbances in cataract, notwithstanding great biochemical advances; however, the progress of preventive medicine and biochemistry will no doubt eventually aid ophthalmologists. There are two types of metabolic disturbance associated with cataract which are particularly prevalent in southern India, namely, hookworm disease and hyperglycemia. In his experience there is nothing to prevent the development of cataract.

Colonel Wright's impressions deserve careful study and consideration; they are derived from an unusually large experience and reflect the sober and critical judgment which has always characterized his writings.

A. KNAPP.

FURNACE WORKER'S CATARACT. A. VOGT, Klin. Monatsbl. f. Augenh. **91:** 721 (Dec.) 1933.

A detailed historical résumé of descriptions of and opinions on cataracts in furnace workers published during the last two centuries is given, and the modern literature and experiments are discussed. Reviewing these sources and his own research with penetrating infra-red rays, Vogt concludes that Hirschberg, Cramer, Birch-Hirschfeld, C. von Hess and other authors were correct in considering furnace worker's cataract a ray cataract. It is a fire cataract, but not a heat cataract. No rays of the spectrum except penetrating infra-red rays may produce cataract on absorption into the lens without damaging the cornea or iris. The ray cataract in albinos is proof of this. The action of visible and ultraviolet rays is genetically irrelevant, and the convection warmth of exogenous heat is not instrumental in this respect. The heat of the sun is no etiologic factor in the production of the fire cataract. Heat emanating from the iris on the lens cannot be adduced etiologically. Colloid-chemical changes of the albumin of the lens may have a causa-

tive effect in connection with short-wave infra-red rays. The axial appearance of the cataract, where the rays hit the lens, and also the absence of irritation of the lids and eyes afflicted with a fire cataract support this view. Yet the thermic and the colloid-chemical etiology are still under discussion. K. L. STOLL.

Lids

AMYOTROPHIC PTOSIS (FUCHS). A. DE LIETO VOLLARO, Arch. di ottal. **40:** 466 (Nov.-Dec.) 1933.

Vollaro reviews the differential diagnosis between this rare condition and blepharochalasis. While in the latter condition the skin is hypertrophic and thickened, in amyotrophic ptosis it is exceedingly thin and transparent and is thrown into many fine folds. Ptosis is constant in amyotrophic ptosis while it is often absent in blepharochalasis. The latter affects young persons, even infants, while the former is seen in older adults. He reports a typical bilateral case, affecting a girl of 19, in whom the condition had begun three years before. The lids covered two thirds of the corneas and were very thin and wrinkled, and the levators were practically without function. They were so stretched that the outline of the pupils could be seen through the lids. Operation according to Angelucci's method was performed, and the skin removed was examined histologically. This showed marked atrophy of the subcutaneous elastic and connective tissue and of the fibers of the orbicularis. The findings were similar to those reported in blepharochalasis, and suggest that the two conditions are nearly related, with the smooth muscle levator more affected in amyotrophic ptosis while there is greater vascular ptosis in typical blepharochalasis. S. R. GIFFORD.

Methods of Examination

OPHTHALMOSCOPIC SURVEY OF THE EYE. L. PAUL, Arch. f. Ophth. **131:** 253 (Nov.) 1933.

In a previous paper (*Klin. Monatsbl. f. Aughenh.* **89:** 730, 1929) Paul described a simple method of measuring angles subtended between any point in the fundus and the optical axis. He also devised a geometric pattern which permitted the transposition of the angular measures into linear measurements on the surface of the globe. Those calculations were valid for the schematic eye. In the present paper he gives a detailed account of his attempts to make the aforementioned pattern applicable to emmetropic eyes of any build. He believes that the focal length of an emmetropic eye can be estimated from its corneal curvature with an error of less than 6 per cent, because the refractive power of the lens parallels more or less the refractive power of the cornea (after Wagner and Zeeman). In a case of abnormal depth of the anterior chamber a special correction has to be made. Following the same principle, acceptable calculations can be made for the ametropic eye also. Only in the case of myopia of high degree is a more individual surveying advisable. Paul believes that measurements of the transverse diameters of the globe (with calipers applied to the living eye in situ) are valuable in determining the shape of the globe.

To define the location of a point lying in front of the focal plane (i. e., in the vitreous) Paul recommends measuring the angles subtended by two rays drawn toward that point through two points located opposite each other in the plane of the pupil. Ophthalmoscopically speaking, this is accomplished by determining the eccentricities at which, for an observer who moves straight across the pupil of the patient, the point in the vitreous appears and disappears respectively. The two rays, thus defined, can be introduced into a drawing of a schematic eye and they will intersect in the point the location of which was to be determined. Paul thinks that this is a practical method of recording graphically the shape of a retinal detachment or of an intra-ocular tumor.

P. C. KRONFELD.

Neurology

THE PATHOGENESIS OF THE PHOTOPSIAS AND OF OPHTHALMIC MIGRAINE. DEDIMOS, Arch. d'opht. **50**: 677 (Oct.) 1933.

Dedimos presents evidence that the photopsias are almost always due to a rise of the arterial pressure in the retina and the visual centers. From this point of view they are comparable to the entoptic phenomena producing visual sensations which are due to irritations of the retinal elements. The photopsias are discussed in four groups: (1) general conditions with hypertension, (2) conditions with increased intracranial pressure, (3) diseases of the eye itself and (4) diseases of the brain and analogous disorders. In the first group are described the photopsias occurring in arteriosclerosis, malaria, polycythemia, epilepsy and poisonings due to lead, quinine and illuminating gas. The probability of hypertension, both local and general, in these conditions is pointed out. In the second group tumor of the brain, injuries to the head and meningeal hemorrhage are shown also to give rise to photopsias which are probably related to hypertension. The third group deals with diseases of the globe that often may give rise to photopsias. These include detachment of the retina, optic neuritis, retinitis, the retinitis of pregnancy, diabetic retinitis, syphilitic chorioretinitis, glaucoma and hemorrhage into the optic nerve. In the fourth group the hemianopias, hyperemia of the brain, tabes and migraine are discussed. The theories which have been proposed to explain the scintillating scotoma in migraine are described at some length. Dedimos believes that the evidence available is not in favor of congestion due to venous spasm as the cause of the scotoma. He supports the suggestion that it may be due to a localized arterial spasm in the visual centers or the retina.

The coexistence of local arterial hypertension and the photopsias in all the conditions mentioned constitutes in his opinion evidence of a relation as cause and effect. He also believes that the irritation giving rise to photopsia is an excitation primarily of the sensitive retinal elements and secondarily of those of the visual cortex. He cites the experiments of Calderaro as showing that it is not a question of nerve-fiber irritation. The increase of the pressure in the central retinal vein does not explain the photopsias. The photopsias are frequently accompanied by other entoptic sensations, such as muscae volitantes and colored vision.

S. B. MARLOW.

CHIASMAL SYNDROMES FROM HYPOPHYSEAL TUMOR CURED BY ROENTGEN THERAPY. A. FERRARI, Arch. di ottal. **40:** 493 (Nov. Dec.) 1933.

In a typical case with complete bitemporal hemianopia and vision of 1/10 in each eye, roentgen treatments were given to five fields at three day intervals, the dosage being 170,000 kilovolts.

Vision increased to 10/10, right, and 8/10, left, after four months, while the fields showed corresponding improvement, the right becoming nearly normal. The literature on cases in which roentgen therapy was used is reviewed. Apparently an adenoma was present in Ferrari's case.

S. R. GIFFORD.

CHIASMATIC ARACHNOIDITIS. JORGE MALIBRAN and MANUEL BALADO, Arch. de oftal. de Buenos Aires **8:** 199 (May) 1933.

After reference to a former case of traumatic arachnoiditis reported by them in which the condition was successfully treated by opening the optic nerve sheath, Malibran and Balado reported a case of similar etiology, in which paleness of the optic nerve disks with rapid loss of sight followed a cranial traumatism. The visual fields showed an enormous central scotoma with relative central scotoma in the remainder of the visual field, characteristic island formation with central depression in the right eye and depression of the upper field in the left, the roentgen observations being negative. Craniectomy with opening of the distended optic nerve sheath, which was thickened, was followed by a marked visual improvement, a reduced central scotoma persisting in both eyes.

A review of the scanty literature on the subject follows, the ophthalmoscopic findings being an atrophy of the optic nerve without prior neuritis, the diagnosis resting on the quantitative perimetry. There are three groups of cases: Those in which the symptoms are typically chiasmatic, those in which there occurs a general perimetric depression and those in which a relative central scotoma is observed, to which last group the reported case belongs. The treatment is purely surgical.

C. E. FINLAY.

HEMIANOPIC HALLUCINATIONS. REPORT OF A CASE. R. KLEIN and R. STEIN, Klin. Monatsbl. f. Augenh. **91:** 805 (Dec.) 1933.

A man, aged 64, came under observation for visual disturbances of his right eye in January 1933. He had suffered a stroke with aphasia and slight weakness of his right side three years prior to admission. His left eye had been removed for sarcoma of the choroid in 1932. He was intelligent and possessed perfect orientation. At his right side he observed poles and spears, which remained about 0.5 meter distant, appeared to be remarkably distinct, and disappeared when he turned his head in their direction. The phantoms seemed to fall on him at an attempt to evade them. The spears and poles were replaced later on by a wall, the face of a woman leaning over the patient, tapestry designs, a fence consisting of perpendicular rods, flowers, etc., always at the same distance; the colors green and red predominated. He had right-

sided, homonymous hemianopia with a small extension of 5 degrees at the center. Only white could be recognized in the right lower quadrant at first; colors were recognized there two weeks later. The pupillary reaction was normal, even when tested with the hemikinesimeter. No neurologic disorder was found aside from Babinski's reaction, slight amnesic aphasia and slight right-sided hemiparesis. Psychic symptoms were absent. Attempts to influence the hallucinatory apparitions with strong concave glasses, prisms and cylinders failed to change their distinctness, shape and distance; their image could not be seen in a mirror and they were observed together with the covering hand. The phantoms followed the motion of the eye in every direction, even somewhat to the left of the median line, as they did in a case reported by Zutt.

The seat of the disturbance was probably somewhere in the optic center centrally from the corpus geniculatum, and the disorder was due to arteriosclerosis, but not to a metastasis of the choroid sarcoma. Hemianopic hallucinations, according to Schröder, are due to a general disturbance of the brain and are observed in the hemianopic defect of the field of vision, where the control is absent to correct the hallucinations. It is important to note that distinct hallucinations appear in the peripheral area of the visual field, an area in which distinct images do not develop under normal conditions. This proves that the relation between the tissues of the retina and the brain center is not applicable for the hallucinations. Of interest, furthermore, is the observation that the hallucinations appeared at a constant direction and at a constant distance, i. e., that relative and absolute egocentric localization existed.

K. L. STOLL.

Ocular Muscles

STRABISMUS AND AVITAMINOSIS. L. DOR, Arch. d'opht. **50**: 667 (Oct.) 1933.

The question of the etiology of strabismus still remains confused. Dor briefly states the various suggestions as to its cause. Believing that it may be due to arrested development imputable to faulty nutrition, he has treated many cases of strabismus with vitamins without greater success than attends the usual methods. Mouriquand showed that vitamin therapy is effective only in recent avitaminosis and is inactive in long-standing conditions. Dor has waited for a recent case of strabismus in a child to try this form of treatment. Such a case he describes in detail. The child was first seen when 11 months old. Its mother had been operated on for convergent strabismus, and other relatives on the maternal side were similarly affected. With the administration of a mixture of vitamins A and D Dor noted the disappearance of the strabismus. When the administration of these vitamins was stopped the strabismus recurred, and disappeared on readministration. Dor discusses the objections which may be raised to this case. He cites another instance in which the mother of a strabismic child had had an enteritis during pregnancy and a diet lacking in vitamins. During a second pregnancy the same diet was used with the addition of vitamins. Strabismus did not occur in the second child. As a result of these observations Dor suggests that while the vitamins may be sufficient for

the normal development of the eyes of a normal child, they may be insufficient for the proper development of those of a child with a hereditary predisposition to strabismus.

S. B. MARLOW.

THIRTY-FOURTH CONTRIBUTION TO THE KNOWLEDGE OF NYSTAGMUS. J. OHM, Arch. f. Ophth. **131**: 401 (Dec.) 1933.

The strongest stimulus to elicit optokinetic nystagmus is a large hollow cylinder which rotates around the patient, who is seated near the center of the cylinder. Thus optokinetic nystagmus can be elicited even in patients with very large central scotomas.

P. C. KRONFELD.

Orbit, Eyeball and Accessory Sinuses

CONGENITAL ABSENCE OF THE SUPERIOR ORBITAL WALL ASSOCIATED WITH PULSATING EXOPHTHALMOS. REPORT OF FOUR CASES. L. T. LEWALD, Am. J. Roentgenol. **30**: 756 (Dec.) 1933.

Lewald believes that congenital absence of the superior orbital wall causes pulsating exophthalmos. The condition is easily distinguished roentgenologically from sarcoma of the orbit, especially in view of the fact that there is usually deformity of the floor of the orbit in addition to the other bony changes. The inferior margin of the orbit may be lower than the corresponding region on the normal side. He reports four cases of congenital absence of the superior orbital wall. In one case the diagnosis was confirmed and a new orbital wall constructed by a bone transplant from the skull (Dandy). In two cases the patients presented associated lesions due to the presence of diffuse neurofibromatosis (Recklinghausen's disease), and in one case, in addition to associated Recklinghausen's disease, the patient showed a congenital arteriovenous fistula of the right leg, causing localized gigantism, and a congenital deformity of the cervical spine. In routine examination of roentgenograms of the head it is advisable for the roentgenologist to make a careful study of the bony outline of the orbits, in addition to the study of the nasal accessory sinuses. Enucleation of the eye or ligation of the carotid artery should never be performed in a case of pulsating exophthalmos unless a roentgen examination has been made and shows no evidence of congenital absence of the superior orbital wall.

J. A. M. A.

TREATMENT OF PULSATING EXOPHTHALMOS. W. B. HAMBY and W. J. GARDNER, Arch. Surg. **27**: 676 (Oct.) 1933.

In May 1930 a review of this condition showed 621 cases reported in the literature. Hamby and Gardner report 2 cases. They believe that the same principles which are taken into account in the treatment of arteriovenous aneurysm elsewhere in the body should govern the procedures in the treatment of intracranial aneurysm. They discuss these principles. The cases which they report are quite different. An artificial muscle thrombus was tried in each. Further procedures were necessary to effect a cure. In the second case a rapid development of anastomoses after ligation was of interest. The authors comment as follows:

"Unfortunately, most of us see so few cases that each is a new experience when it confronts us. It is obvious, however, that the 'routine' treatment by ligation of a carotid artery is inadequate to cure this lesion completely and that rational, effective treatment is yet to be determined. These cases demonstrate that such a progressive lesion often requires a progressive attack, and that it should be energetically dealt with until such a time as a successful outcome seems assured."

L. L. MAYER.

EXOPHTHALMIC GOITRE WITHOUT INCREASED BASAL METABOLIC RATE. I. BRAM, Endocrinology **17**: 23 (Jan.-Feb.) 1933.

Bram discusses 220 cases of exophthalmic goiter in which there was neither an increase above the conventional normal basal metabolic rate nor a loss in weight. Seventy-four of the patients were untreated; 8 had cases of protracted duration with "burned out" thyroid; 12 had been treated with preparations of iodine prior to coming under observation; 117 had undergone subtotal or total thyroidectomy, and 9 had received excessive roentgen treatment. The data derived from these cases appear to indicate that a high metabolic rate is not imperative in the diagnosis of exophthalmic goiter. It appears that the disease is not analogous to hyperthyroidism, and that the syndrome may occur without demonstrable thyroid excitation.

EDITOR'S ABSTRACT. [J. A. M. A.]

UNILATERAL EXOPHTHALMOS IN INTRACRANIAL TUMORS, WITH ESPECIAL REFERENCE TO ITS OCCURRENCE IN MENINGIOMAS. C. A. ELSBERG, C. C. HARE and C. G. VAN DYKE, Surg., Gynec. & Obst. **55**:681 (Dec.) 1932.

Elsberg and his associates found marked unilateral exophthalmos in 15 of 807 patients who had intracranial tumors. Most of the tumors associated with exophthalmos were meningeal fibroblastomas, but one was a primary carcinoma of a sweat gland of the scalp; one, an epidermoid in the middle cranial fossa, and two, orbito-ethmoid osteomas. In one case the exophthalmos was due to Paget's disease with intracranial complications. Unilateral exophthalmos may also occur with metastatic carcinoma and with venous and arteriovenous angiomas. Often the protrusion of one eyeball was the only symptom for a number of years. The exophthalmos was most frequently on the left side in females and on the right side in males. In many of the patients there was also a cranial hyperostosis, visible when on the vertex, and demonstrable by means of roentgen rays when on the base. The protrusion of the eyeball was most often due to perforation of the tumor into the orbit, thickening of the orbital walls, extension of the growth through an enlarged superior orbital fissure, or increase of pressure in the middle cranial fossa directly transmitted to the orbital contents through the superior orbital fissure. There was no positive evidence in any case that the unilateral exophthalmos was the result of compression of the cavernous sinus or of the ophthalmic veins and venous stasis.

EDITOR'S ABSTRACT. [J. A. M. A.]

ORBITO-OCULAR LESIONS IN FRACTURES OF THE CRANIUM. RAUL ARGAÑARAZ and JOSÉ SEÑÁ, Arch. de oftal. de Buenos Aires **8:** 6 (Jan.-Feb.) 1933.

After a review of the mechanical, sensitive, motor and sensorial lesions that can be produced by fractures of the cranium, the authors report three cases of (1) monocular blindness following a blow on the right side of the forehead, in which a lesion of the nerve in the optic canal was diagnosed and confirmed at operation, in which, however, operation produced no visual benefit; (2) monocular loss of sight with oculomotor paralysis from a fracture involving the orbital apex, in which a decompression benefited the general symptoms but not the local; (3) pulsating exophthalmos following an automobile accident with injury of the carotid in the cavernous sinus, treated with some benefit by periodic compression of the carotid and intragluteal injection of gelatin.

C. E. FINLAY.

Pharmacology

A REPORT ON THE CLINICAL VALUE OF THE SODIUM SALT OF N-METHYL-CYCLO-HEXANYL-METHYL BARBITURIC ACID. (Anesthetics Committee, Medical Research Council) Brit. M. J. **2:** 63 (July 8) 1933.

The sodium salt of n-methyl-cyclo-hexanyl-methyl barbituric acid is used intravenously. The use of this preparation in Germany in 25,000 cases, with only 1 death, is reported. In cats, 25 mg. gives full anesthesia, while the lethal dose is 100 mg. (therapeutic quotient of 4). In dogs, the quotient is 3.3. The anesthetic action is of rapid onset and short duration, as the drug is rapidly detoxicated by the liver. Some is excreted unchanged in the urine. The blood pressure decreases from 15 to 20 mm. in animals. An overdose causes cessation of breathing, the heart beating for some time afterward. There is no evidence of any effect on metabolism.

At present, this preparation is supplied in powdered form in ampules to which distilled water, supplied in another ampule, is added, making a 10 per cent solution. It is injected intravenously at the rate of 1 cc. in fifteen seconds; 3 cc. usually produces unconsciousness. Lauber has the patient count. When the patient ceases to count, the amount injected is noted; then the same amount is added for a short operation and twice as much for a long one. In elderly and feeble people and in those who sleep quickly, only half the amount which produced sleep is added. Usually 10 cc. is the maximum dose. For long operations, as much as 20 cc. may be injected.

Symptoms produced include a deep yawn just before unconsciousness occurs. Muscular relaxation varies but is rarely sufficient for an abdominal operation. The pupils dilate, and conjunctival and corneal reflexes disappear. However, reflex movement may occur at the start of an operation. There is a slight decrease in the blood pressure. No sedative is used before the preparation is given. The operation may be started two minutes after the injection is completed, and unconsciousness lasts from ten to twenty minutes. The degree of anesthesia obtained varies moderately.

In general, this preparation is not a basal narcotic (like phenobarbital sodium). Its action is very evanescent, and, if used before another anesthetic, it is to be classed with nitrous oxide and ethyl chloride. After-effects are unusual, and the preparation can be relied on as an excellent anesthetic for short operations in which slight reflex movement is not a matter of great concern. W. F. DUGGAN.

Physiology

RETENTION OF FUNCTION BY THE EYES IN OLD AGE AND AFTER DEATH. W. WEGNER, Deutsche med. Wchnschr. **59:** 1883 (Dec. 22) 1933.

Wegner attempts to answer the question whether with the physiologic death of man the eye loses its functional ability. He cites the changes occurring in the eye as it ages—the loss of accommodative power, the sclerosis of the nucleus of the lens, the narrowing of the pupil and the production of the arcus senilis—as normal criteria of increased life of the eye. Since the weight of the brain decreases by 7 per cent in the aged it is natural to anticipate like losses in the retina and optic nerve. It has been shown, however, that exposure of the eye to light is a necessary stimulus for a normal revival of the existing visual purple of the retina. By means of Starling's heart-lung preparation Wegner has been able to demonstrate that after a minimum of twenty-two minutes without an adequate supply of blood the eye again regains its function. When a period of forty-five minutes has elapsed without continuous circulation of blood in the eye restitution of function is impossible. It is concluded that with the death of the entire organism the eye has not lost its ability to function and therefore is not dead in the true sense of the word. L. L. MAYER.

Refraction and Accommodation

CHANGES IN ASTIGMATISM. E. JACKSON, Am. J. Ophth. **16:** 967 (Nov.) 1933.

The writer calls attention to changes in astigmatism and cites his own case as an example. A previous report on the changes in astigmatism due to corneal section is referred to, and a table is given showing these changes. A second article is referred to which dealt with astigmatic changes occurring after the age of 40. A new study of 632 eyes deals with patients observed for from five to fifty-three years. An outstanding fact is that corneal astigmatism in eyes free from local corneal disease remains much the same throughout life. Total or clinical astigmatism, however, shows changes, the meridian of greatest refraction usually being vertical in early life and horizontal in later life. Reasoning by exclusion, it is evident that these changes depend on changes in the lens. It is important, therefore, that the eyes be remeasured whenever symptoms due to uncorrected astigmatism arise. W. S. REESE.

THE ACCOMMODATION TIME IN HYPERTHYROIDISM. G. ROSSI, Arch. di ottal. **40:** 483 (Nov.-Dec.) 1933.

Using the same method employed with a previously reported series of pregnant women, Rossi examined ten pregnant women with hyper-

thyroidism, showing the usual ocular signs of increased sympathetic irritability. He found a slightly delayed reaction time, the average for each patient varying from thirty to thirty-nine seconds, while the time for normal persons varied from ten to twenty-five seconds. He considers that this is due to a slight insufficiency of the ciliary muscle resulting from a disturbed vagosympathetic balance.

S. R. GIFFORD.

THE MYOPIC FUNDUS DEGENERATION IN ANISOMETROPIA. H. URIO, Arch. f. Ophth. **131: 377** (Dec.) 1933.

One of Vogt's associates, Urio, brings up the question of anisometropia in order to prove the absurdity of the various mechanical theories concerning the development of myopia. Thirty-five anisometropes of the University Eye Clinic in Zurich, Switzerland, were studied. Thirty-four showed the myopic crescent either alone (scleral conus or peripapillary atrophy of the choroid) or combined with degeneration of the macula in the eye that had the higher degree of myopia. The latter also had, as a rule, a lower intra-ocular tension than its mate. "If one considers the fact that in many of those cases the more myopic eye on account of divergent strabismus never takes part in any close work, one can readily see the irrationality of the 'muscle pressure' or of the 'gravity' theory."

P. C. KRONFELD.

LENTICULAR ASTIGMATISM. L. SALLMANN, Arch. f. Ophth. **131: 492** (Dec.) 1933.

Two methods have been in use for the determination of lenticular astigmatism, namely, direct ophthalmometry of the lens with the ophthalmophacometer of Tschernig, and a computation based on the supposition that the total astigmatic error as determined by retinoscopy or by subjective methods is the algebraic sum of corneal and lenticular astigmatism. The first method is difficult, cumbersome and unreliable. The second method is inaccurate, because it necessitates several measurements whereby errors may creep in.

Sallmann approached the problem by making retinoscopic examination of the eyes the corneal astigmatism of which was eliminated by a contact glass. A strong light source and homatropine cycloplegia were used. The results were very satisfactory.

At first ten aphakic eyes (after intracapsular extraction) were examined in that way (under atropine cycloplegia); no astigmatic error was found. Among ninety nonaphakic eyes the following relative frequencies prevailed for the various degrees of "noncorneal" astigmatism:

Diopters.....	0	0.25	0.50	0.75	1	1.25	1.50	2
Patients.....	6	12	15	17	22	12	4	2

In the cases of high "noncorneal" (II) astigmatism the total (III) and the corneal (I) astigmatism were also determined. The combined action of I and II, as computed after Krämer, checked very closely with the results of direct skiascopic determination of III. Sallmann concluded that any astigmatism remaining after eliminating the corneal astigmatism must be lenticular.

The direction of the low degrees of lenticular astigmatism was usually opposite, and that of the higher degrees parallel, to that of the corneal astigmatism. The main meridians of the cornea and lens subtended, as a rule, angles between 10 and 35 degrees.

On a few selected observers Sallmann studied by subjective methods the behavior of lenticular astigmatism during accommodation (fixation of nearby objects and also overcorrection with concave lenses for distance) and found very definite rotations of the lenticular main meridians toward the corneal main meridians. P. C. KRONFELD.

Retina and Optic Nerve

ANGIOID STREAKS OF THE RETINA. P. BONNET, Arch. d'opht. **50**: 721 (Nov.) 1933.

The observation presented by Bonnet, with colored illustrations, is representative of the usual changes in the fundus and central vision which characterize this condition. It also falls into the group of cases which lend support to the contention of Gronblad that "the ophthalmoscopic picture of angioid streaks is encountered in patients afflicted with a cutaneous disease, pseudoxanthoma elasticum, characterized anatomically by degeneration of the elastic tissue of the skin. The angioid streaks are only a manifestation in the eye of a generalized disturbance of elastic tissue." Bonnet presents his personal observation in detail. The characteristic ophthalmoscopic features of this condition are fully described—the pigmented streaks, the clear spaces of the retina, the pigmentary changes at the equator, the periphery of the fundus and the changes at the macula. The slowly progressive development in the course of which acute processes involve the macula is discussed, with citation of some of the cases already described. The pathogenesis of the disease is presented from the point of view of anatomic examination and the interpretation of the ophthalmoscopic picture. So far as anatomic evidence is concerned there is none available which is completely satisfactory. Ophthalmoscopic investigations have resulted in the suggestion of various possibilities for the nature of the lesions. The streaks have been thought to be the results of hemorrhages, of occlusion of blood vessels, and of pigmented folds and tears in the retina. The clear spaces about the streaks have been explained by depigmentation, organization and tears in the lamina basalis. The changes in the equatorial zone have been associated with the pigmented epithelium, the alterations at the macula with an exudative choroiditis. The disease is rare and always bilateral. Gronblad found ninety cases recorded in the literature. It is more often seen after middle age and is more frequent in men than in women. It may be familial. There is no relationship to myopia, and general examination of the patient as a rule discloses no possible etiologic factors. Since Gronblad's report in 1929 ten additional cases associated with pseudoxanthoma elasticum have been reported. The author supports the idea that the process primarily takes place in the inner layers of the choroid and can be due to elastic tissue degeneration. A full bibliography is appended. S. B. MARLOW.

BIOMICROSCOPY OF THE VITREOUS IN DETACHMENT OF THE RETINA. F. CARAMAZZA, Rassegna ital. d'ottal. **2:** 1123 (Dec.) 1933.

Eighteen cases studied repeatedly before and after operation allow the following conclusions:

In retinal detachment the changes in the vitreous are constant, and, in some respects, characteristic. Operative intervention does not cause any marked change in the biomicroscopic picture.

It cannot be affirmed yet with assurance whether the vitreous changes noted are preexistent or subsequent to detachment. Fluidification, microfibril degeneration, striate opacities and the presence of fine pigmented granules and of unpigmented elements are and can be preexistent, for they are seen in the other eye without detachment. Other findings are not so easily interpreted. It seems that the presence of pigmented epithelial elements is secondary to detachment and is caused, or at least favored, by contact of fluid vitreous and pigmented retinal epithelium.

A more systematic study of the vitreous with the slit lamp in patients having premonitory symptoms, just before a detachment, may yield valuable information for a better understanding of the pathogenesis and prognosis of this condition.

Twenty colored plates are included. They are beautifully executed and illustrate profusely the vitreous changes described.

V. R. SYRACUSE.

ENDOVASCULITIS AND PERIVASCULITIS OF RETINAL VESSELS. PAULINA SATANOWSKY, Arch. de oftal. de Buenos Aires **8:** 44 (Jan.-Feb.) 1933.

A case is reported in which there was gradual loss of sight in one eye of five years' duration and in which, in the affected eye, a white connective tissue projected into the vitreous from the papilla, from which pearly white striae surrounded and followed retinal vessels to the retinal periphery, while others terminated in the retina somewhat beyond the disk margins. Clinical and biologic observations were negative. There was no history of tuberculous antecedents; the patient showed no evidence of diabetes, septic foci or syphilis. The only similar case which Satanowsky has been able to find described in the literature was one of Meyer, reported by Leber. She refers to another case of hers in which after a thrombosis of the central retinal vein a white spot was observed at the macula, apparently of syphilitic origin.

C. E. FINLAY.

SURGICAL TREATMENT OF OPTIC NERVE ATROPHY. RICARDO MOREA, Arch. de oftal. de Buenos Aires **8:** 71 (March) 1933.

The chiasm and the optic nerves may be the seat of variously originated lesions, which permit a correct localization. These may be brought about through compression by a tumor, persistent intracranial hypertension and inflammation of the arachnoid enveloping the optic nerves and chiasm. Lesions of the latter type are the subject of this paper. Knowledge of these dates back only two or three years. Although in prior cases the lesions had been successfully treated by

operation without recognition of their nature, the first operation performed purposely with a prior diagnosis was that by Balado on Nov. 8, 1929. Following this the lesions in similar cases were treated by other Argentine operators and subsequently by others in different countries. The author describes at length the anatomic conditions at the chiasm with the relations of the arachnoid sheath, which here is separated from it and the optic nerves by an appreciable space filled with cerebrospinal fluid. The pathologic examination of the excised arachnoid shows a spindle cell new formation of membrane.

The inflammation may be due to irritation by a tumor with prior production of inflammation of the meningeal sheath and secondary optic neuritis followed by atrophy; to acute and chronic inflammations of the brain and meninges, often due to syphilis, and to infectious processes and diabetes.

The visual field changes are various and of different character, and a distinguishing feature is their existence without deformation of the sella turcica.

The treatment consists in opening the arachnoid sheath after exposure by temporal or transfrontal approach.

Morea reports ten cases, with the clinical observations (including those of the visual fields), descriptions of the operations and the results.

C. E. FINLAY.

THE IMPORTANCE OF THE VITREOUS IN THE GENESIS OF DETACHMENT OF THE RETINA. A. VON RÖTTH, Klin. Monatsbl. f. Augenh. **91**: 682 (Nov.) 1933.

The chief problem of the pathogenesis of detachment of the retina is centered on the question of the origin of the tear. The following factors may cause a tear in idiopathic detachment: (1) degeneration of the retina, (2) liquefaction of the vitreous and (3) detachment of the vitreous in the form of a "vitreous ring," which von Rötth found in nine of nineteen cases. In four cases shreds of the vitreous were found attached to the torn off flap of the retina. These changes of the vitreous are responsible for the origin of tears. Experiments with a model resulted in the production of a tear with subsequent detachment of the retina.

Detachments of the vitreous, but not of the retina, were found in two of fifty-five highly myopic eyes.

The tear was located in the temporal portion of the retina in 75 per cent of all the cases of detachment. This is explained by the fact that the temporal peripheral portion is farther removed from the central arteries and receives less nutrition than the nasal peripheral portion of the retina.

K. L. STOLL.

ATROPHY OF THE OPTIC NERVE OF ANGIOSPATIC ORIGIN. REPORT OF A CASE. ZOLTAN TOTH and K. MESZAROS, Klin. Monatsbl. f. Augenh. **91**: 815 (Dec.) 1933.

A woman, aged 70, became suddenly blind in the left eye when she stepped out into the cold air. Two months later vision in the right eye began failing. She had never been sick but had noticed for about four

years that her fingers became white and numb in the cold. A severe vasomotor neurosis existed. Arteriosclerosis was absent.

The sudden and permanent blindness of the left eye was attributed to angiospastic irregularities of the peripheral vessels, analogous to the syncope of the hands, giving rise chiefly to anemia in the area of the central retinal artery and causing secondary atrophy of the optic nerve. Angiospastic changes had impaired the vision of the right eye, which was greatly improved by intravenous injections of a 40 per cent solution of dextrose. Amblyopias of unknown origin may be caused by irregularities of the small vessels.

K. L. STOLL.

Trachoma

STUDIES ON TRACHOMA: III. THE SUSCEPTIBILITY OF RHESUS MONKEYS TO CONJUNCTIVAL INFECTION BY BACTERIUM GRANULOSIS UNDER VARIOUS EXPERIMENTAL CONDITIONS. C. WEISS, J. Immunol. 25: 227 (Oct.) 1933.

Weiss points out that the present method of isolating Bacterium granulosis is laborious and uncertain. Testicular extract did not increase the virulence of old cultures. Attempts to lower the general resistance of monkeys to infection with Bact. granulosis were unsuccessful. Attempts to reduce the local (conjunctival) resistance of monkeys to infection by massage, by irritation with dust, aleuronat, starch and benzene and by simultaneous or previous infection with hemoglobinophilic bacilli gave negative results. The observation of Noguchi, Olitsky, Knutti and Tyler and Thygeson that characteristic lesions of granular conjunctivitis ("monkey trachoma") may be initiated in rhesus monkeys by inoculation of freshly isolated virulent strains of Bact. granulosis, but better by infected monkey tissue containing this organism, was confirmed. No filtrable virus or auxiliary agent was demonstrated in the conjunctival lesions of monkeys used in transmission experiments. Several monkeys in which no gross evidence of follicles appeared after inoculation with Noguchi's bacillus showed microscopic changes indicative of a chronic inflammation. Weiss concludes that spontaneous folliculosis of rhesus monkeys is a disease distinct from that produced by the inoculation of virulent cultures of Bact. granulosis. A bibliography is given.

L. L. MAYER.

STUDIES ON TRACHOMA: IV. THE DIRECT TRANSMISSION OF HUMAN TRACHOMATOUS LESIONS TO VARIOUS ANIMALS. C. WEISS, J. Immunol. 25: 247 (Oct.) 1933.

Weiss achieved 56 per cent successful transmission of trachoma in monkeys (Macacus rhesus) by previous irritation of the conjunctiva with powdered Portland cement. The fresh infected tissue used for inoculation was derived from human beings. Transmission in series from monkey to monkey was accomplished. Clinically and histologically the lesions resembled those found in other varieties of monkeys. The New World monkey (Cebus capucinus) was also susceptible. No evidence of a filtrable virus was found in the lesions in monkeys. Neither was an inclusion-producing virus found in the serial passage of human

trachomatous material from brain to brain or from testis to brain in mice or rabbits. A bibliography is supplied. L. L. MAYER.

STUDIES ON TRACHOMA: V. THE AGGLUTINABILITY OF BACTERIUM GRANULOSIS IN SERA OF TRACHOMA PATIENTS. C. WEISS, J. Immunol. **25**: 259 (Oct.) 1933.

The serums of fifty-five patients with trachoma were tested against two strains of Bacterium granulosis (Tu 3.4 and MC) and forty of these against strain 1R. The method is outlined in detail. The results recorded in the tables indicate that, in general, agglutination of Bact. granulosis occurs more frequently in the serums of patients with trachoma than in that of normal persons. The death of localized agglutinins agrees with the findings in other ocular conditions. A bibliography is given. . L. L. MAYER.

TRACHOMATOUS HYPERPLASIA OF THE GLANDS OF MOLL. R. ARGAUD and M. A. CANGE, Arch. d'opht. **50**: 663 (Oct.) 1933.

It is pointed out in this paper that while the essentially erosive and destructive lesions of trachoma are well recognized, the adenomatous hyperplasia which may occur has generally escaped attention. The histologic study of some cases has demonstrated to the authors the great changes which take place in the glands of Moll, to such an extent that an adenomatous formation occurs. They point out that two processes take place at the same time, one of necrosis, the other of hyperplasia. The histologic appearances of these are described.

S. B. MARLOW.

RECURRENCES OF TRACHOMA AND THE LAWS OF TRUE TRACHOMA. C. PASCHEFF, Arch. di ottal. **40**: 455 (Nov.-Dec.) 1933.

Pascheff reviews his conclusions from clinical and histologic observations in trachoma, including the examination of confluent follicles in tissue removed from the cornea. He reports a case in which there was a recurrence (proved by histologic sections) two years after an apparently complete cure, and another similar occurrence in a child after twenty-one months. The child's mother was also affected with trachoma, and Pascheff speaks of the hereditary character of the disease, without mentioning the likelihood of infections by contact. S. R. GIFFORD.

REPEATED EXPRESSIONS IN TRACHOMA. I. WASSERMAN, Sovet. vestnik oftal. **3**: 399, 1933.

Wasserman treated 107 patients in the first and second stages of trachoma with repeated expressions of the follicles. In 91 patients a complete recovery was obtained, as the conjunctiva remained smooth, no cicatrices or recurrence being observed within eighteen months. In 12 patients the treatment resulted in partial improvement, and in 4 no improvement of the condition was noticed. Expression was repeated from three to six times with an interval of from four to six weeks. Expression was followed by a daily swabbing of the conjunctiva with a solution of 1 per cent silver nitrate seven or eight times, with no

medical treatment at home in the intervals. The ages of the patients ranged from 1 to 25 years, as Wasserman believes that the school age is the most favorable and he selected the patients accordingly. Repeated expressions stimulate the local reaction of the tissue; they conserve much time and energy of the patient as well as of the physician, and Wasserman therefore strongly advocates this form of treatment for trachoma.

O. SITCHEVSKA.

Tumors

CYST OF THE UVEAL LAYER OF THE IRIS. A. E. TOWN, Am. J. Ophth. **16:** 790 (Sept.) 1933.

The author reviews the literature of cysts of the uveal layer of the iris and reports a case in a man, aged 32, whose left eye was practically blind and presented a large ciliary staphyloma. In the right eye the slit lamp revealed small pigmented deposits on the posterior surface of the cornea. A brown, tumor-like mass protruded about 1 mm. behind the posterior surface of the iris into the posterior chamber. The mass was barely translucent and was tremulous. The tension of the eye varied around 30. As the mass was increasing in size it was removed by means of a broad iridectomy. Shortly afterward the lens became opaque, necessitating its removal. Vision of 6/18 was obtained, and the tension has averaged 36

W. S. REESE.

A BILATERAL CANCER OF THE UVEA SECONDARY TO A PRIMARY CARCINOMA OF THE LUNG. B. SIEGRIST and G. CRAMER, Ann. d'ocul. **170:** 116 (Feb.) 1933.

This article gives a complete report of the clinical and postmortem findings in a man of 45 years who was found to have carcinomatous tumors of the choroid secondary to carcinoma of the lung. The small number of instances in the literature are noted. The carcinomatous tumors of the choroid involved both eyes. They appeared to start from the center of the papillary area and extended to the ora serrata. The comment is offered that fairly often primary cancer of the chest as well as that of other organs is found in a roundabout way. The objective and subjective symptoms are often so insignificant as to escape notice. The discovery then depends on roentgenology or the autopsy. In other cases the symptoms due to the metastases in organs far from the primary site attract the attention of the patient or the doctor. In the case reported here, attention was first drawn to the metastatic carcinoma of the uvea. The primary malignant disease in the chest progressed insidiously to the time when it was revealed only by pain in the side and a hemorrhage of the lungs. There are three illustrations.

S. H. MCKEE.

PLASMOCYTOMA OF THE CONJUNCTIVA. W. KREIBIG, Arch. f. Ophth. **131:** 89 (Oct.) 1933.

The term "plasmoma" or "plasmocytoma" is purely descriptive and is used for a tumor consisting only of plasma cells. The localization, clinical symptoms and macroscopic appearance of the plasmoma vary considerably from one case to another. The pathologists, therefore,

assume that there are several different pathologic entities which all cause the same histologic picture.

Kreibig reports two cases representing two different types of plasmocytoma. The first was that of an elderly patient who for some time had been suspected of having trachoma. A slow growing tumor developed in one lower fornix. The tumor was removed, and sections showed, under the normal epithelium, a massive infiltrate, very indistinctly defined against the deeper layers, which consisted almost exclusively of plasma cells. These cells followed vessels and nerves some distance into the healthy tissue. In the thickly infiltrated area the stroma of the conjunctiva was hardly visible. Below the epithelium were small groups of round cells, distinctly separated from the plasma cells. The case represents the plasmoma of "inflammatory origin," which is nearly always caused by trachoma.

The second case was that of a woman, 46 years of age, who had had multiple small tumors in the respiratory tract, which proved to be plasmocytomas. A slow growing tumor developed in the right upper lid. The growth looked like a chalazion but on removal was found to be an encapsulated plasmocytoma which replaced the lateral half of the tarsus. Only very few leukocytes were found near the capsule. The conjunctiva which covered the tumor was normal. Nine months after the removal of the tumor no recurrence was noted on the eyelid while in the respiratory tract the formation of nodes continued. This case also represents a definite pathologic entity, although its classification and etiology are still uncertain.

P. C. KRONFELD.

TWO RARE OPHTHALMOSCOPIC FINDINGS IN SARCOMA OF THE CHOROID. R. H. MERRILL, Klin. Monatsbl. f. Augenh. **91**: 598 (Nov.) 1933.

The ophthalmoscopic and pathologic findings in two cases of sarcoma of the choroid are reported.

The growth in the first case, a diffuse sarcoma (*Flächensarkom*) showed only a slight prominence with indistinct peripheral outlines in the posterior pole of the globe and an adjoining zone which might have been mistaken for rarefied or sclerotic choroidal tissue. The normal appearance of the disk proved that the tumor spared an annular healthy zone around the disk. Radial folds of the retina were observed between the disk and the involved area. The prominence later extended to the disk, which lost its distinct outline. The patient refused to permit enucleation until several attacks of glaucoma occurred four years after the beginning of observation.

In the second case the diagnosis was rendered more difficult by extraordinarily heavy pigmentation in the posterior pole of the eye and by interspersed hemorrhages and white foci in the closely attached retina. The increase of an initially slight prominence established the diagnosis later. The tumor, in Merrill's opinion, represented the early stage of the type of sarcoma which finally perforates the retina and protrudes into the vitreous in the shape of a pedunculated knob. It consisted chiefly of spindle cells.

K. L. STOLL.

Uvea

HETEROCHROMIA AND CATARACT. A. E. EDGERTON, Am. J. Ophth. **16:** 1076 (Dec.) 1933.

Edgerton discusses heterochromia, its etiology, its various types, the possible relation to a disturbance of the sympathetic nerve, etc. He reports the case of a man, aged 46, who had noticed poor vision in the right eye several years previously. At that time the pale iris, lens changes and vitreous opacities were noted. Physical examination showed no abnormality. The x-ray picture revealed some thickening of the right frontal sinus, and the reaction to tuberculin was slightly positive. The right iris was pale blue while the left was brown. The right lens was cataractous, and biomicroscopy revealed precipitates on the posterior surface of the cornea and atrophy of the iris. A combined extraction was successfully performed on the right eye. W. S. REESE.

Vitreous

VASCULARIZATION OF THE WHOLE VITREOUS IN A CASE OF HEMORRHAGIC RETINITIS WITH THE RETENTION OF NORMAL ACUITY OF VISION. D. V. GIRI, Brit. J. Ophth. **18:** 24 (Jan.) 1934.

A woman, aged 62, was first seen by the author in 1919, when the eyes were healthy. Ten years later there were numerous flame-shaped hemorrhages in the central region of the retina. From then on increasing vascularization of the vitreous took place until it was complete. The branching of the vessels was dichotomous, all of the branches ending in loops and constituting an unbroken network. Vision was 6/6 partly. There was a considerable loss of the nasal field.

The patient was given glandular extracts, organic iodine and theobromine calcium salicylate. To this treatment are ascribed in a great measure the absence of fibrosis, the clarity of the vitreous and the remarkable acuity of vision. Subsequently the retina became detached. The article is illustrated. W. ZENTMAYER.

NEW VESSEL FORMATION IN THE VITREOUS. G. FLINT and D. HARRINGTON, Brit. J. Ophth. **18:** 27 (Jan.) 1934.

Four cases of formation of new vessels in the vitreous are reported. The first case occurred in a man, aged 22, with kerato-iritis in both eyes. Later retinal hemorrhages, with a new-formed delicate vascular membrane, developed in the right eye. The Wassermann reaction was negative, but the patient reacted strongly to tuberculin. Although the cause was considered to be syphilis, the condition grew progressively worse in spite of antisyphilitic treatment. Later there was regression in the vascularization.

The second case occurred in a woman, aged 56. Following the clearing of massive hemorrhages in the vitreous, new-formed vessels were seen at the disk, the convoluted net extending far forward into the vitreous. Both the hemorrhages and the vessels disappeared in time. No factor could be assigned as a cause of the hemorrhages.

The third case occurred in a man, aged 55. The left eye was blind from detachment of the retina following preretinal hemorrhage and

extensive retinitis proliferans. In the right eye there were hemorrhages in the retina and the vitreous. After from six to eight months new vessels were seen running from the disk and from the neighborhood of some of the retinal veins from which bleeding had occurred. Later the vessels regressed, with clearing of the vitreous. There was an active tuberculous process in the lungs. The Wassermann test was negative. Treatment was confinement to bed and administration of a tuberculin preparation.

The fourth case occurred in a man, aged 52, with a history of syphilitic infection. The Wassermann reaction of the serum and spinal fluid were negative. The tuberculin test was positive. In the left eye there were retinal and preretinal hemorrhages. After several months of treatment, both antisyphilitic and with a tuberculin preparation, little change was noted. About one year later new-formed vessels sprang from the retina into the vitreous. With clearing of the vitreous the vessels regressed.

The new vessel formations are looked on as reparatory agents whose function was solely the removal of the extraneous "foreign matter" in the vitreous.

In three of the cases the fundus is depicted. W. ZENTMAYER.

Therapeutics

THE EMPLOYMENT OF PERCAINE IN OCULAR THERAPEUTICS. FRANCISCO BORDÁS, Arch. de oftal. hispano-am. **32: 597** (Nov.) 1932.

Nupercaine (α-butyloxicinchonic acid diethylethylenediamide hydrochlorate) is a derivative of the quinoleic group and has no relation to cocaine, procaine hydrochloride and the like substances, which belong to the benzene group. Bordás has employed it as a collyrium in 0.5 to 1 per cent concentrations in 0.9 per cent sodium chloride solution or in injections in the dilution of 1 to 2: 1,000 combined with epinephrine. It is a vasodilator producing some hyperemia, which can be avoided by the addition of epinephrine. He gives details of its use and concludes that it is quite as efficacious as other anesthetics, and in much weaker solutions. A wait of from ten to thirty minutes is necessary to obtain a perfect action. He has not been able to confirm the claim of a more lasting effect, but has never observed a secondary local or general harmful action. The coincident ocular hyperemia is not a contraindication, being in some cases favorable. The slight primary burning sensation is lessened by commencing with a 0.5 per cent solution. It has no visible action on the corneal epithelium. It can be sterilized by boiling.

C. E. FINLAY.

Book Reviews

Atlas Fundus Oculi. By William Holland Wilmer, M.D., LL.D., Sc.D., Professor of Ophthalmology and Ophthalmologist-in-Chief to the Johns Hopkins Hospital. With an introduction by Warfield T. Longcope, M.D.. Price, $35. Pp. 114, with 100 color plates. New York: The Macmillan Company, 1934.

This handsome quarto volume includes fourteen pages devoted to a fresh and lucid exposition of ophthalmoscopy and one hundred plates in color, each with its page of descriptive text.

The paintings of the fundus were made by Mrs. A. S. Burgess and are on a large scale, the optic disks being from 2 to 3 cm. in width. Most of the paintings are dated, the years ranging from 1926 to 1933. The artist used the self-illuminating ophthalmoscope, and the colors appear natural. One does not find, for example, the excessive green of the glaucomatous disk shown in Jaeger's atlas, made under the greenish light of the kerosene lamp soon after the invention of the ophthalmoscope, or the excessive pink of the atrophied disk found in some later atlases, made under the reddish light of the Argand gas burner or the early electric bulb with the carbon filament.

The plates were made by A. Hoen and Company of Baltimore after an offset lithographic process which is an improvement on the old direct lithograph and the more recent three-color halftone. However, one who has not had paintings reproduced by a color process cannot realize the technical difficulties involved or be aware of the tedious corrections required with the inks and the several printing surfaces in order to achieve satisfactory results. In the case of this atlas the paintings seem to have been faithful in drawing and color, and the reproductions excellent.

The hundred plates cover adequately the ordinary important conditions of the fundus and also offer a number of rare conditions, such as metastatic carcinoma of the choroid, prepapillary arterial loop and hemiangioma of the retina.

The first plates show the coloring of the fundus with different varieties of body pigmentation—the chocolate-colored fundus of the Negro, the chocolate-red fundus of the Mulatto, the reddish-brown fundus of the Hindu and North American Indian, the yellow fundus of the Chinese, the dark, tigroid fundus of the brunette, the orange-red fundus of the blond and the pale fundus, yellow in the periphery, of the albino. Following these are plates of the fundus as it appears in the more common laboratory animals—the monkey, dog, cat, rabbit and guinea-pig. Next come six plates showing congenital anomalies; the remaining eighty-one present pathologic conditions.

Accompanying each plate of the pathologic group, the page of text, though concisely written, gives in full the diagnosis and the family and past history, describes the present illness and the results of the physical examination, laboratory examination and examination of the eyes, and presents a detailed description of the fundus. Eight

plates show papilledema and papilloretinitis. The description of these conditions is happily free from the former nomenclature relating to the optic nerve, with its confusing terms, such as choked disk, ascending and descending neuritis and the like. Nineteen plates show choroidoretinitis, in ten of which the condition is tuberculous, the large number being in keeping with the diversity of these lesions. Eight plates show retinal arteriosclerosis and arteriolosclerosis, states with which one cannot be too familiar. Several plates present thrombosis and embolism, and six show retinal pictures with morbid changes in the blood. Altogether, the hundred plates form a comprehensive and highly instructive collection.

Since copies of many of the better atlases are now rare and as atlases with poor plates are not particularly illuminating, there will be a wide field for this admirable new work, and the author, artist, lithographer and printer are to be congratulated on the splendid result of their coordinated labors. WARD A. HOLDEN.

Neurology. By Roy R. Grinker. Price, $8.50. Pp. 960 with illustrations and diagrams. Springfield, Ill.: Charles C. Thomas, Publisher, 1934.

The relationship of ophthalmology to neurology is a vital one. Especially is this true from the standpoint of anatomy and physiology. Dr. Roy R. Grinker in "Neurology" has clearly outlined the anatomy of the visual pathways in combination with a sound physiologic conception of their function and their relationships in the central nervous system. He has also carefully handled the subject of the extra-ocular muscles and their central connections. Though these subjects are well presented in a number of separate works, their intimate correlation with other cerebral functions is not always so clearly presented.

Neurologic disorders frequently involve the visual and oculomotor pathways. Therefore, the ophthalmologist is often called on to assist in localizing the lesion producing such disorders. As a consultant, his understanding of the interrelationship of ophthalmology and neurology is necessary. The ophthalmologic findings in both intracranial and extracranial disorders are reviewed. Intracranial neoplasms, multiple sclerosis and myasthenia gravis are especially well treated. As such a wealth of material is presented, ophthalmologists as well as neurologists should find the book a valuable reference work. J. T. STOUGH.

CORRECTION

In the article by V. La Rocca, entitled "Alterations of Retina in Experimental Toxic Nephrosis" in the October issue (ARCH. OPHTH. **12**:509, 1934), the line, "From the research department of the Brooklyn Eye and Ear Hospital," near the bottom of the page, was inserted through error; Doctor La Rocca is not connected with that hospital.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Prof. F. de Lapersonne, 217 Faubourg St. Honoré, Paris.
Secretary-General pro tem: Dr. A. Churchill, 66 Boulevard St. Michel, Paris.

International Ophthalmologic Congress

Secretary: Dr. Francisco Poyales, Olozaga 3, Madrid.

FOREIGN

British Medical Association, Section on Ophthalmology

President: Dr. Frank H. Crawley, 5 Fitzwilliam Pl., Dublin.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Road, Bombay 4.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Ophthalmological Society of the United Kingdom

President: Mr. A. H. H. Sinclair, 6 Charlotte Square, Edinburgh.
Secretary: Mr. Humphrey Neame, 56 Portland Place, London, W. I.

Oxford Ophthalmological Congress

Master: Dr. C. G. Russ Wood, Hill House, Abberbury Rd., Iffley, Oxford, England.
Hon. Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 4-6, 1935.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. A. C. Hudson, 50, Queen Anne St., W. 1, London.
Secretary: Dr. J. D. Magor Carbell, 27, Weymouth St., W. 1, London.

Société Française d'Ophthalmologie

Secretary: Dr. René Onfray, 6 avenue de la Motte Picquet, Paris 7è.

Society of Swedish Ophthalmologists

President: Prof. F. Berg, Uppsala, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö., Sweden.

German Ophthalmological Society

Secretary: Prof. A. Wagenmann, Heidelberg.

NATIONAL

American Medical Association, Scientific Assembly, Section on Ophthalmology

Chairman: Dr. Arthur J. Bedell, 344 State St., Albany, N. Y.
Secretary: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Place: Atlantic City, N. J. Time: June 10-14, 1935.

American Academy of Ophthalmology and Otolaryngology

President: Dr. J. M. Wheeler, 635 W. 165th St., New York.
President-Elect: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
Executive Secretary-Treasurer: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Cincinnati. Time: 1935.

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* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

American Ophthalmological Society

President: Dr. Walter B. Lancaster, Boston.
Secretary-Treasurer: Dr. J. Milton Griscom, 2213 Walnut St., Philadelphia.
Place: Hot Springs, Va. Time: June 5-7, 1935.

National Society for the Prevention of Blindness

President: Mr. William Fellows Morgan.
Managing Director: Mr. Lewis H. Carris, 50 W. 50th St., New York.
Place: New York. Time: Dec. 6, 1934.

SECTIONAL

New England Ophthalmological Society

President: Dr. Hugo B. C. Riemer, 128 Newbury St., Boston.
Secretary-Treasurer: Dr. Benjamin Sachs, 483 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Frank B. Kistner, Mayer Bldg., Portland, Ore.
Secretary-Treasurer: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Place: Portland, Ore. Time: Spring, 1935.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Francis A. Brugman, 509 Olive St., Seattle.
Secretary-Treasurer: Dr. Noble Dick, 1115 Terry Ave., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. Harry Shearer, 405 E. Grand Ave., Beloit, Wis.
Secretary-Treasurer: Dr. W. S. Beyer, 1101 Talcott Bldg., Rockford, Ill.
Place: Rockford, Ill., Janesville or Beloit, Wis. Time: Third Tuesday of each month.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. Charles H. Baker, 805 Washington Ave., Bay City, Mich.
Secretary-Treasurer: Dr. W. K. Slack, 308 Eddy Bldg., Saginaw, Mich.
Place: Saginaw, Mich., or Bay City, Mich. Time: First Friday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. John B. Gregg, 101 S. Main St., Sioux Falls, S. D.
Secretary-Treasurer: Dr. F. H. Roost, 420 Trimble Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Dunbar Roy, 113 N. Pryor St., Atlanta, Ga.
Secretary: Dr. William A. Wagner, 914 American Bank Bldg., New Orleans.
Place: New Orleans. Time: 1934.

Southwestern Michigan Triological Society

President: Dr. Carl Snapp, 604 Medical Arts Bldg., Grand Rapids.
Secretary-Treasurer: Dr. Lee O. Grant, 420 Medical Arts Bldg., Grand Rapids.
Time: Third Thursday of alternate months.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. O. G. A. Barker, 532 Main St., Johnstown.
Secretary-Treasurer: Dr. C. W. Beals, Weber Bldg., DuBois.
Time: Third Thursday of October and May.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Edna M. Reynolds, 227, 16th St., Denver.
Place: Capitol Life Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. Arthur M. Yudkin, 257 Church St., New Haven.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.
Time: May, November.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. Herschel C. Crawford, 26 Lindon Ave., N. E., Atlanta.
Secretary-Treasurer: Dr. J. A. Smith, 700 Spring St., Macon.
Place: Atlanta. Time: May 7-10, 1935.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Fred Overman, 611 Hume-Mansure Bldg., Indianapolis.
Place: Richmond. Time: Dec. 12, 1934.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. F. Boiler, 105 E. Iowa Ave., Iowa City.
Secretary-Treasurer: Dr. Lawrence A. Taylor, 118 E. Second St., Ottumwa.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. John W. Orr, 503 S. Saginaw St., Flint.
Secretary: Dr. D. R. Heetderks, 26 Sheldon Ave., S. E., Grand Rapids.
Place: Battle Creek. Time: 1934.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. James A. Reynolds, 78 S. 9th St., Minneapolis.
Secretary-Treasurer: Dr. Walter E. Camp, Medical Arts Bldg., Minneapolis.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. Lawrence G. Dunlap, 101 Main St., Anaconda.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr. James A. Fisher, 501 Grand Ave., Asbury Park.
Secretary: Dr. William K. Campbell, 96 Third Ave., Long Branch.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. Webb W. Weeks, 20 E. 53rd St., New York.
Secretary: Dr. John F. Fairbain, 925 Delaware Ave., Buffalo.
Place: Albany. Time: May 13-15, 1935.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. R. Winn, 702 First Ave., S., Fargo.
Secretary-Treasurer: Dr. F. L. Wicks, 516 Fourth St., Valley City.
Place: Minot. Time: June, 1935.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. A. B. Dykman, Medical Dental Bldg., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. Nathan Bolotow, 108 Waterman St., Providence.
Secretary and Treasurer: Dr. Gordon J. McCurdy, 122 Waterman St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Walter Bristow, Medical Bldg., Columbia.
Secretary: Dr. J. W. Jervey, Jr., 101 Church St., Greenville.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. C. D. Blassingame, 899 Madison Ave., Memphis.
Secretary-Treasurer: Dr. Ralph O. Rychener, 130 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. C. C. Cody, 1304 Walker Ave., Houston.
Secretary: Dr. O. M. Marchman, 1719 Pacific Ave., Dallas.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. F. R. Slopanskey, 9 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. T. F. Welsh, 920 Boston Bldg., Salt Lake City.
Time: Third Monday of each month.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Beverley R. Kennon, 142 W. York St., Norfolk.
Secretary-Treasurer: Dr. George G. Hankins, Medical Arts Bldg., Newport News.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. W. F. Beckner, 1050 Fifth Ave., Huntington.
Secretary: Dr. F. O. Marple, First Huntington National Bank Bldg., Huntington.
Place: Wheeling. Time: May 1935.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Alfred Stahl, 55 Lincoln Park, Newark, N. J.
Secretary: Dr. A. Russell Sherman, 671 Broad St., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. W. L. McDougall, 50 Whitehall St., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 13 Queen's Park. Time: 8 p. m., last Thursday of each month.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Lloyd B. Whitham, Mt. Vernon Pl. and Charles St., Baltimore.
Secretary: Dr. Mary L. Small, 18 W. Read St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. John H. Bailey, 855 St. Marks Ave., Brooklyn.
Secretary-Treasurer: Dr. George Freiman, 703 Grand St., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. H. H. Glosser, 448 Franklin St., Buffalo.
Secretary-Treasurer: Dr. I. J. Koenig, 40 North St., Buffalo.
Time: Second Thursday of each month.

Chicago Ophthalmological Society

President: Dr. E. V. L. Brown, 122 S. Michigan Ave., Chicago.
Secretary-Treasurer: Dr. Thomas D. Allen, 122 S. Michigan Ave., Chicago.
Place: Medinah Michigan Avenue Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. A. L. Stotter, 1148 Euclid Ave., Cleveland.
Secretary: Dr. James T. Collins, 1105 Medical Arts Bldg., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. P. Chamberlain, 7405 Detroit Ave., Cleveland.
Secretary: Dr. A. D. Ruedemann, Cleveland Clinic, Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. John Milton Griscom, 2213 Walnut St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. W. C. Davis, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer:. Dr. H. M. Sage, 9 Buttles Ave., Columbus, Ohio.
Place: Athletic Club. Time: First Monday of each month.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. W. Mood Knowles, 1719 Pacific Ave., Dallas, Texas.
Secretary: Dr. L. H. Quinn, 4015 Live Oak St., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. C. C. Walker, 410 6th Ave., Des Moines, Iowa.
Secretary-Treasurer: Dr. Grace Doane, 614 Bankers Trust Bldg., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month, September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Raymond S. Goux, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. Arthur F Holding, 142 Washington Ave, Albany.
Secretary-Treasurer: Dr. W. C. Mott, 214 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. E. L. Howard, 600 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1012 Medical Arts Bldg., Fort Worth.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Grand Rapids Eye, Ear, Nose and Throat Society

President: Dr. Carl F. Snapp, 26 Sheldon Ave., Grand Rapids, Mich.
Secretary-Treasurer: Dr. Walter W. Oliver, 320 Medical Arts Bldg., Grand Rapids, Mich.
Place: Various local hospitals. Time: Third Thursday of alternating months, September to May.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. E. L. Goar, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. J. C. Dickson, 622 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. D. A. Bartley, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. Raymond E. Teall, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. A. W. McAlester, 2003 Bryant Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Russell T. Uhls, 110 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. Kenneth C. Brandenburg, 707 Security Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Oto-Laryngology

President: Dr. F. H. Brandt, 1136 W. Sixth St., Los Angeles.
Secretary-Treasurer: Dr. Pierre Viole, 1930 Wilshire Blvd., Los Angeles.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:30 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye, Ear, Nose and Throat Society

President: Dr. Charles Dwight Townes, 332 W. Broadway, Louisville, Ky.
Secretary-Treasurer: Dr. J. S. Bumgardner, 1103 Heyburn Bldg., Louisville, Ky.
Place: French Village. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. R. S. Pendexter, 900, 17th St., N. W., Washington.
Secretary: Dr. Lyman B. Tibbets, 1801 Eye St., N. W., Washington.
Place: 1718 M St., N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

Secretary-Treasurer: Dr. Herbert G. Schmidt, 238 W. Wisconsin Ave., Milwaukee.
President: Dr. O. P. Schoofs, 324 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., fourth Tuesday of each month.

Montreal Ophthalmological Society

President: Dr. J. A. MacMillan, 1410 Stanley St., Montreal, Canada.
Secretary: Dr. A. L. Guertin, 410 Sherbrooke St., West, Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Frederick E. Hasty, 119 Seventh Ave. N., Nashville, Tenn.
Secretary-Treasurer: Dr. Kate Savage Zerfoss, 803 Medical Arts Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to June.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Secretary-Treasurer: Dr. R. H. Fisher, Chess and Checker Club, New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Webb William Weeks, 20 E. 53d St., New York.
Secretary: Dr. Guernsey Frey, 121 E. 60th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. John H. Judd, 107 S. 17th St., Omaha.
Secretary-Treasurer: Dr. Robert H. Rasgorshek, 425 Aquila Court, Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m., dinner; 7 p. m., program; third Wednesday of each month from October to May.

Philadelphia County Medical Society, Eye Section

Chairman: Dr. Charles R. Heed, 1205 Spruce St., Philadelphia.
Secretary: Dr. Sidney L. Olsho, 235 S. 15th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Pittsburgh Slit-Lamp Society

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. F. H. Lee, 501 E. Franklin St., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. E. W. O'Brien, 5 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. W. D. Edwards, 389 Monroe Ave., Rochester, N. Y.
Place: Rochester Medical Association, 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ophthalmic Society

President: Dr. E. C. Spitze, 234 Collinsville Ave., East St. Louis, Ill.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. Robert E. Parrish, 712 Medical Arts Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. Frank Steed, Nix Professional Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Robert S. Irvine, 490 Post St., San Francisco.
Secretary: Dr. Frank H. Rodin, 490 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco.
Time: Fourth Tuesday of every month except May, June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. W. L. Atkins, 940 Margaret Pl., Shreveport, La.
Secretary-Treasurer: Dr. Leon F. Gray, 1214 Slattery Bldg., Shreveport, La.
Place: 1240 Texas Ave. Time: 8:15 p. m., fourth Tuesday of every month except June, July and December.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Marc Anthony, 422 Riverside Ave., Spokane, Wash.
Secretary: Dr. Raymond A. Lower, 1455 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. D. F. Gillette, 109 S. Warren St., Syracuse, N. Y.
Secretary-Treasurer: Dr. W. J. Werfelman Jr., 725 State Tower Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Clarence E. Hill, 160 Bloor St., West, Toronto.
Secretary: Dr. A. Lloyd Morgan, 86 Bloor St., West, Toronto.
Time: First Monday, November to April.

Tulsa Academy of Ophthalmology and Otolaryngology

President: Dr. Roy Dunlap, Medical Art Bldg., Tulsa, Okla.
Secretary-Treasurer: Dr. Marvin D. Henley, Medical Arts Bldg., Tulsa, Okla.
Place: Medical Arts Bldg. Time: Monthly.

Washington, D. C., Ophthalmological Society

President: Dr. William Thornwall Davis, 927 Farragut Sq., Washington, D. C.
Secretary-Treasurer: Dr. James N. Greear Jr., 1740 M St., N. W., Washington, D. C.
Place: Episcopal Eye and Ear Hospital. Time: 8 p. m., first Thursday in November, January, March and May.